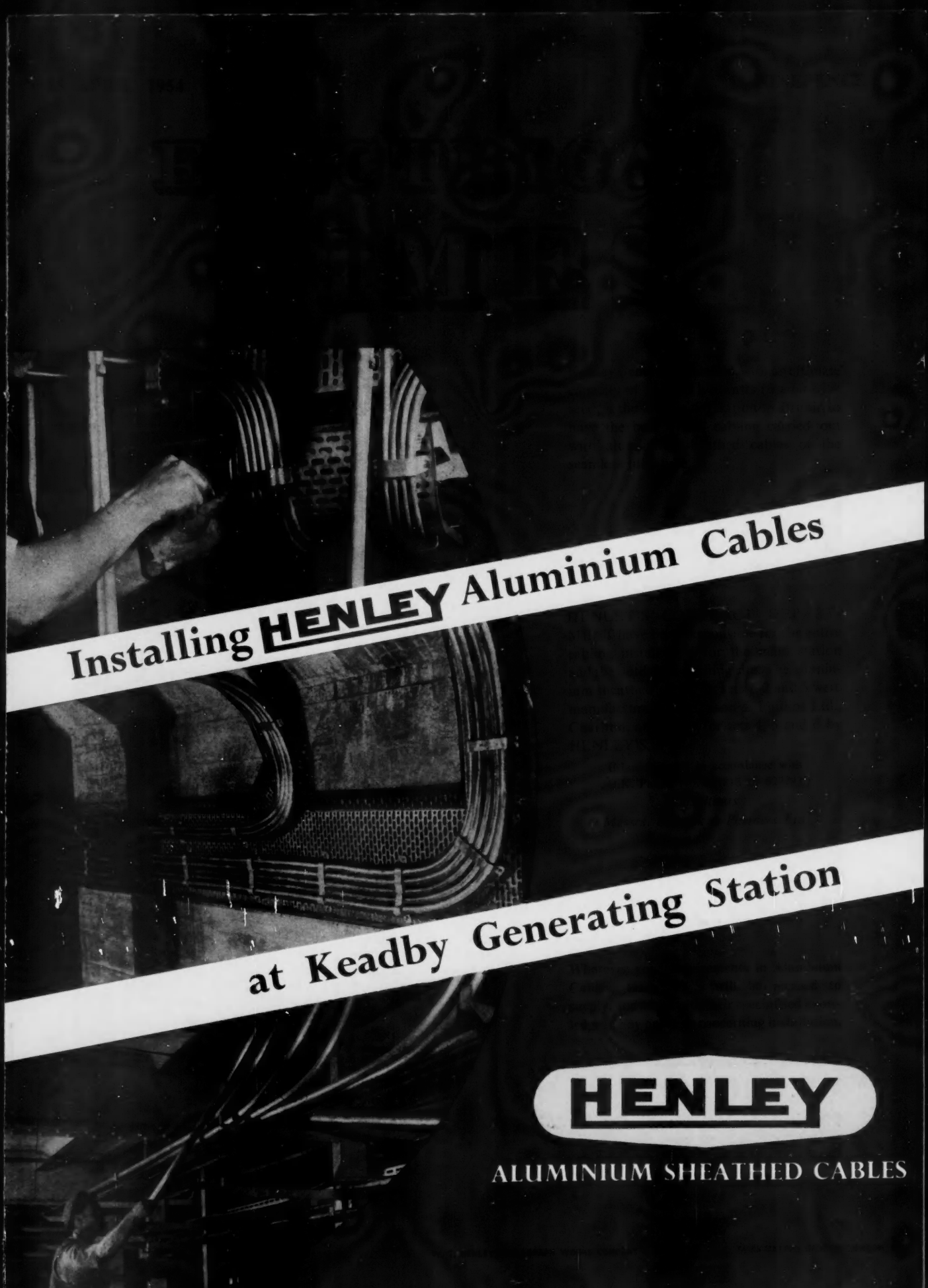

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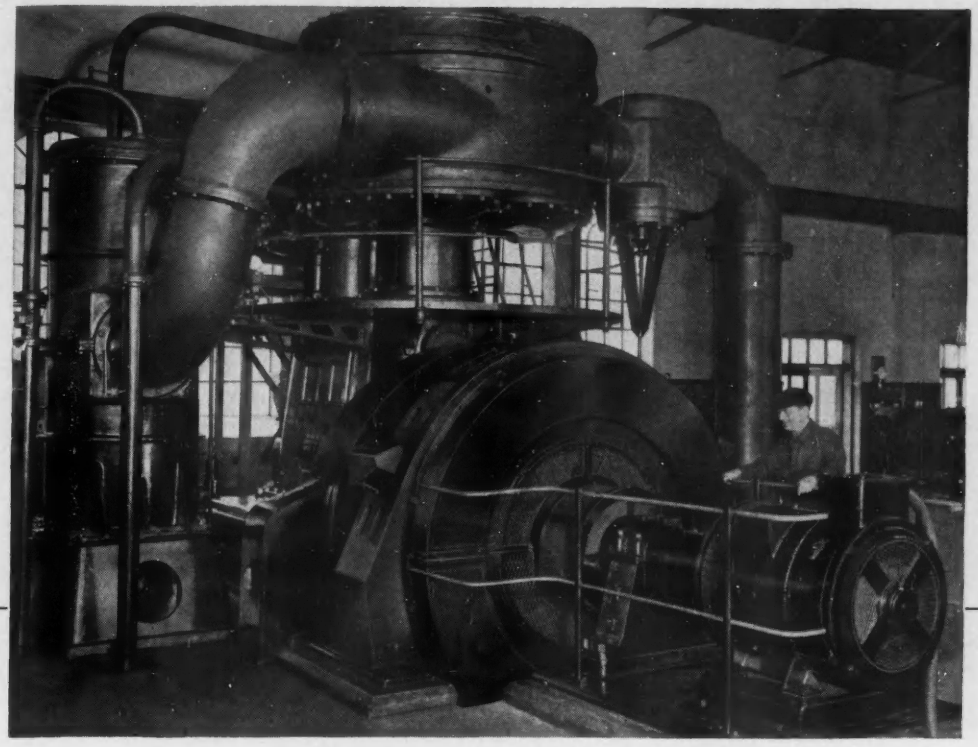

'ENGLISH ELECTRIC' manufacture motors of the salient-pole, wound-rotor synchronous-induction, and salient-pole synchronous-induction types for use on constant speed drives where unity or leading power factor is required. Illustrated is a 'GLS' salient-pole synchronous-induction motor driving a large air compressor at a colliery. This machine combines the high efficiency of the salient-pole type with the relatively high starting torque and low starting current of the wound-rotor synchronous-induction motor.

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synchronous motors

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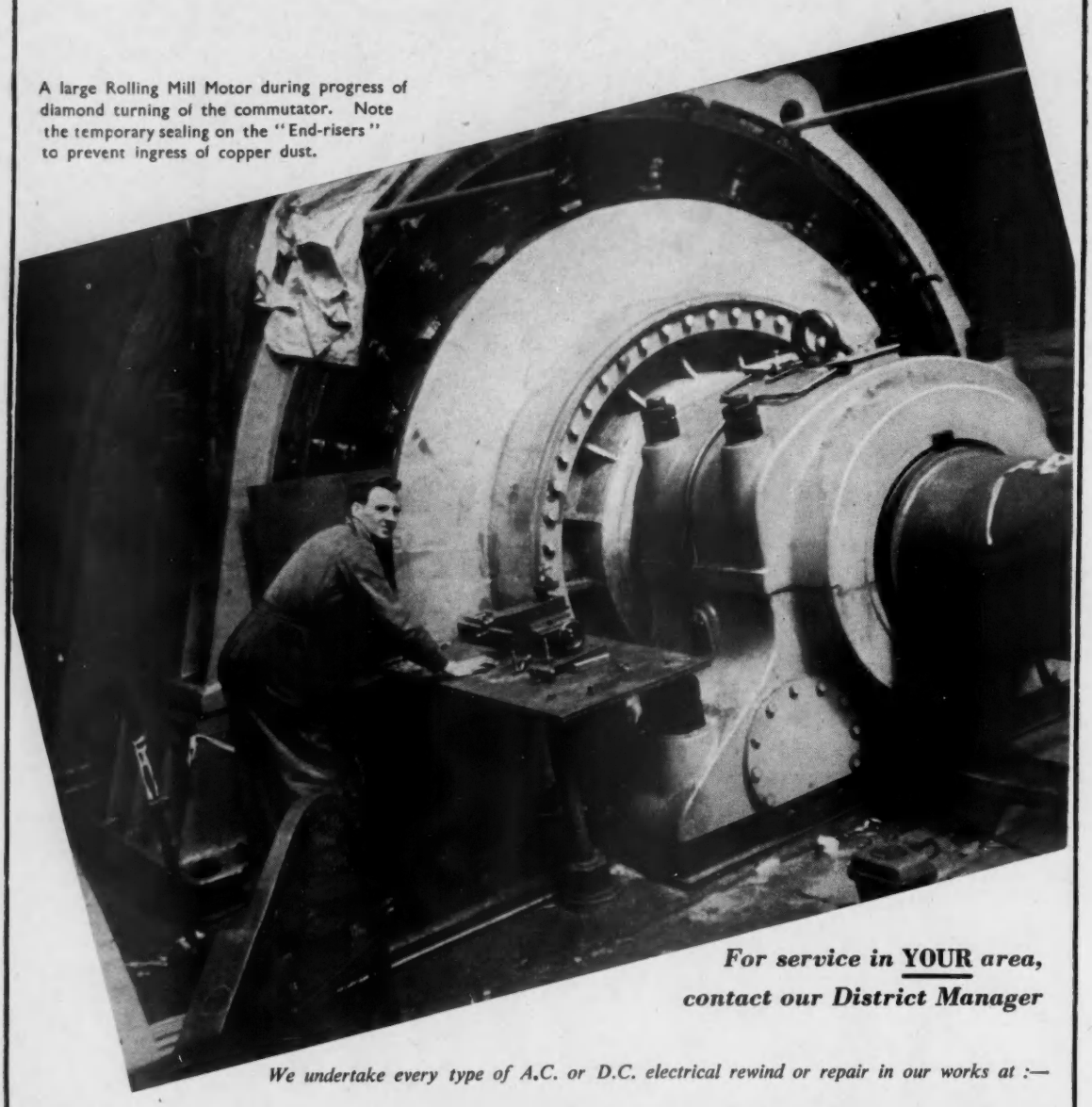
PS. 8A4

A

an example

. . . of on site service given to users of large machines of this type

A large Rolling Mill Motor during progress of diamond turning of the commutator. Note the temporary sealing on the "End-risers" to prevent ingress of copper dust.



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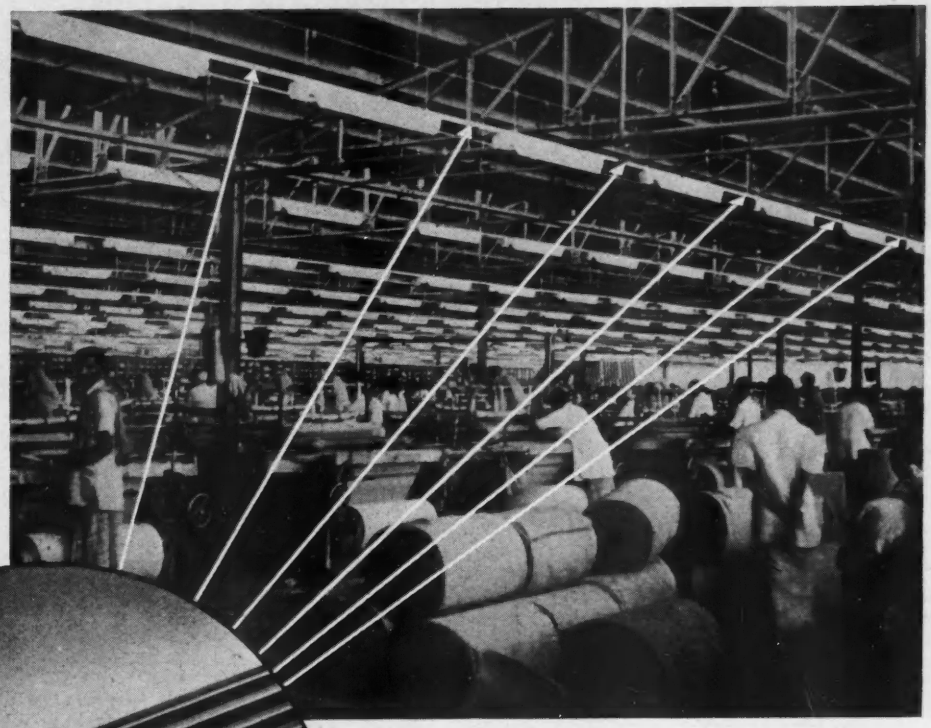
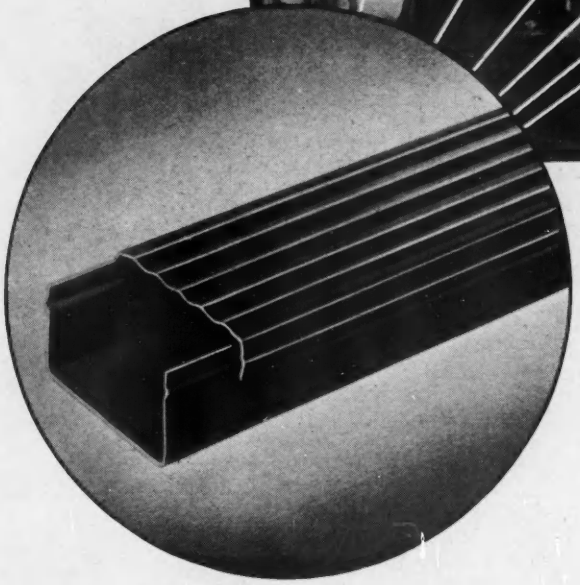
M-W.347

CHANNEL CONDUIT INSTALLED IN THE WORLD'S 3 LARGEST JUTE MILLS

In this view of the loom section of Adamjee No. 1 Mill B.T.H. fluorescent lighting fittings are seen attached to 2" x 1" Channel Conduit.

Photograph reproduced by permission of Engineering Consultant H. M. NIMMO, M.Sc., B.E., A.M.I.E.E.)





The Adamjee Mills at Narayanganj in the Dominion of Pakistan are claimed to be the largest of their kind in the world. Each of the three mills covers an area of about 500,000 sq. ft.

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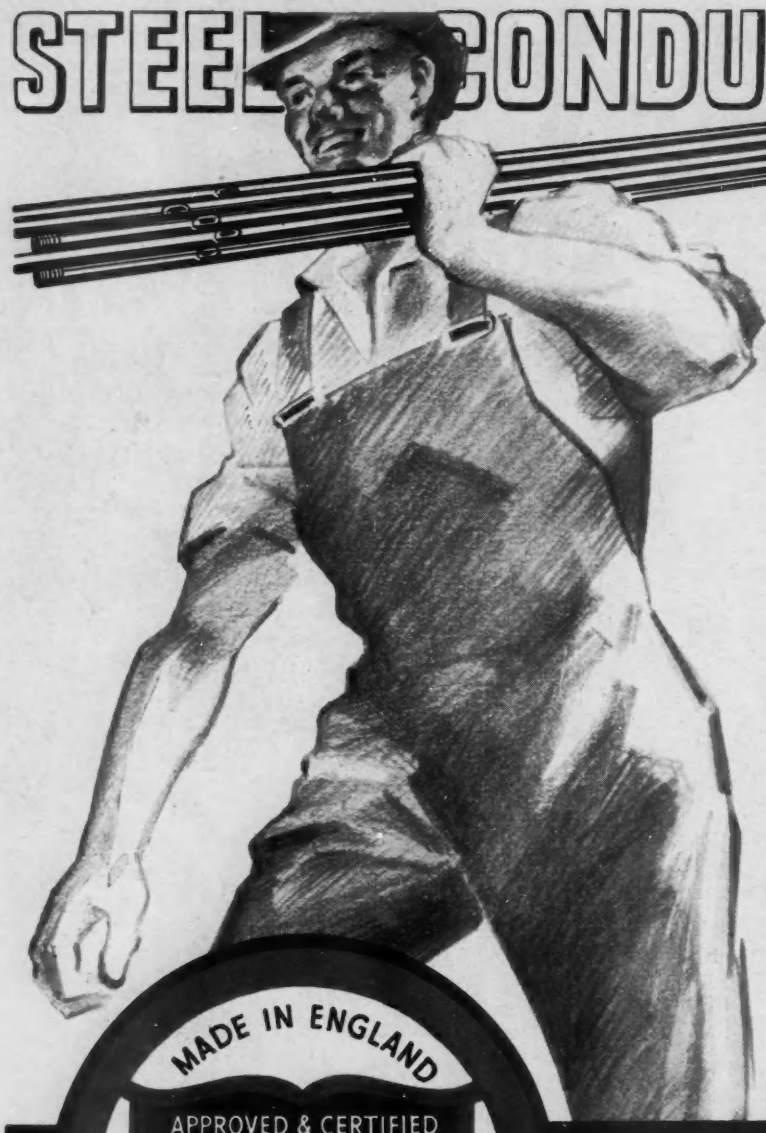

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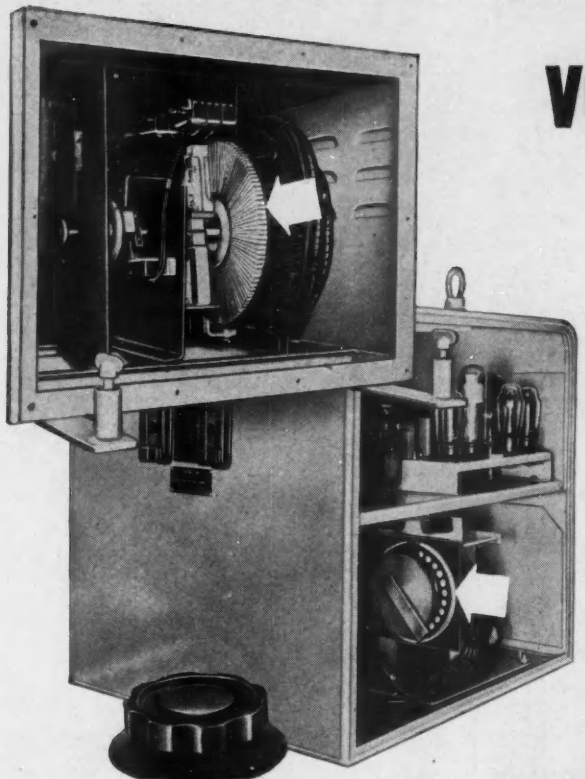

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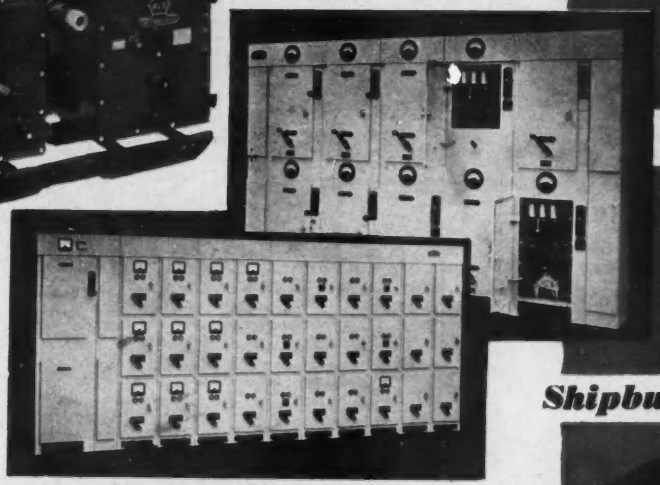

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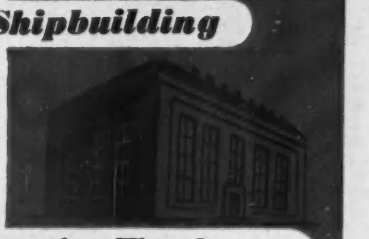

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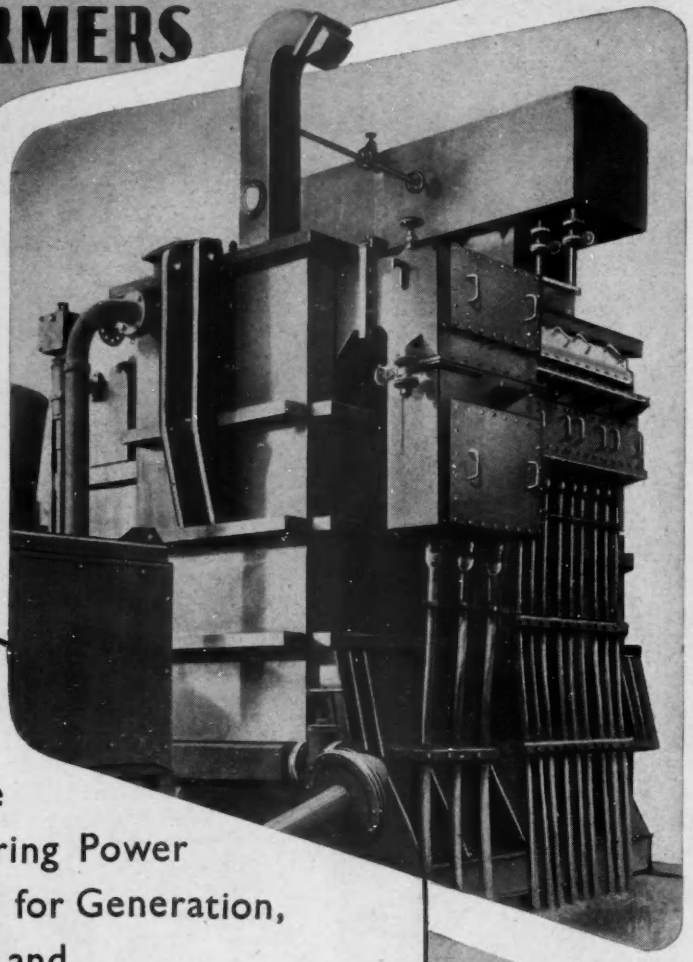

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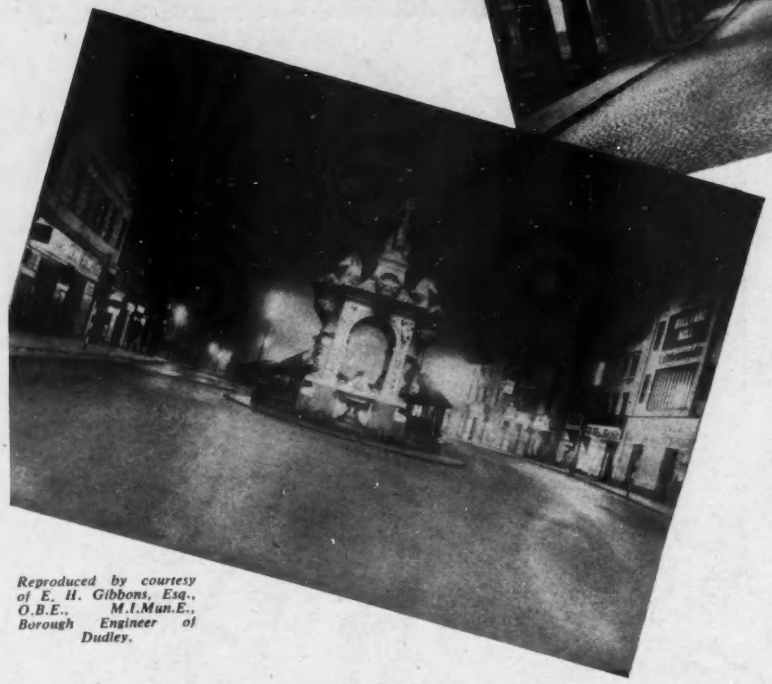

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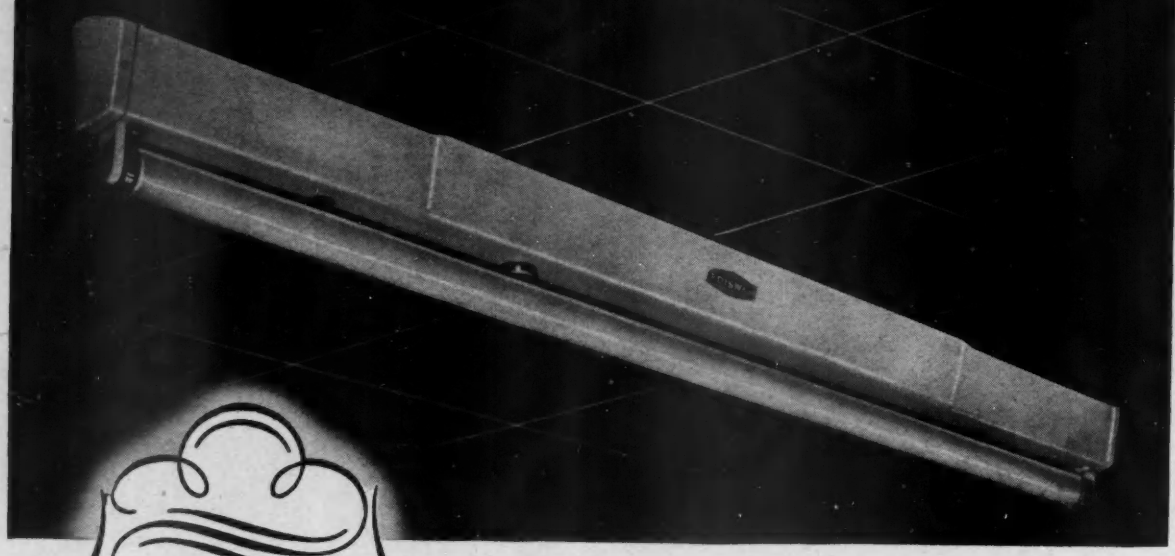

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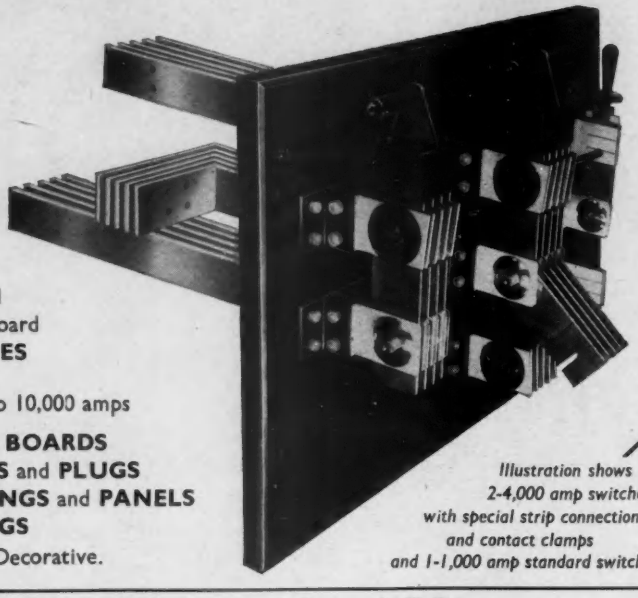

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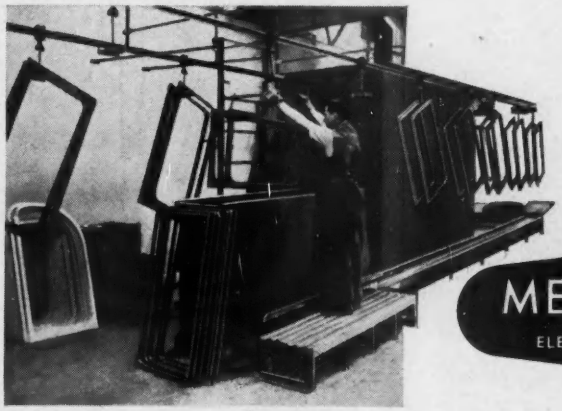

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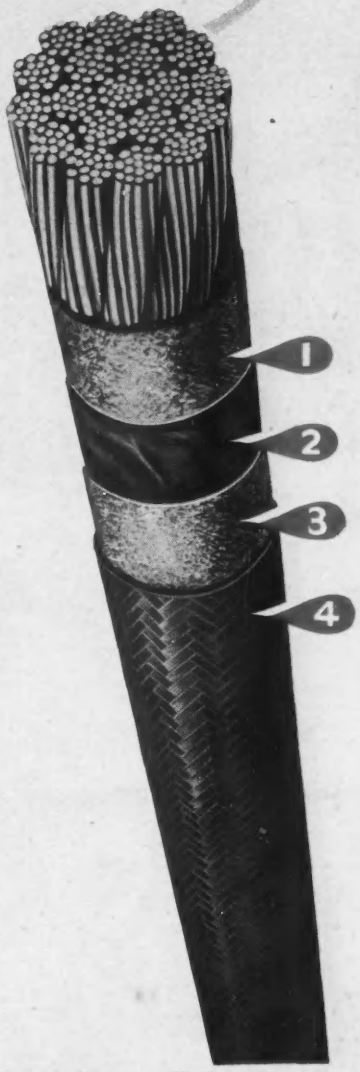

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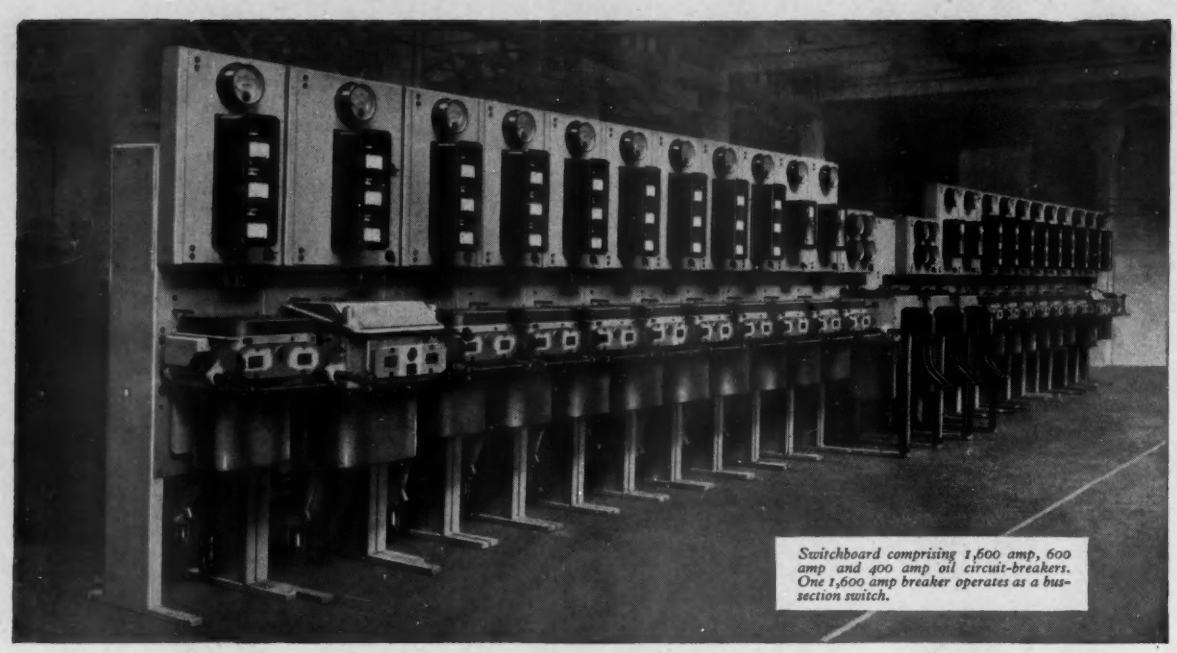

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Model 8 UNIVERSAL AVOMETER

20,000 ohms per volt *plus* AUTOMATIC Overload Protection

Produced in response to a demand for a high sensitivity version of the world-famous Universal AvoMeter, this model incorporates the traditional design features of its predecessors, so highly valued for simplicity of operation and compact portability.

It has a sensitivity of 20,000 ohms per volt on all D.C. voltage ranges and 1,000 ohms per volt on A.C. ranges from 100 V upwards. A decibel scale is provided for audio frequency tests. In addition, a press button has been incorporated which reverses the direction of current through the moving coil, and thus obviates the inconvenience of changing over test leads when the current direction reverses. It also simplifies the testing of potentials, both positive and negative, about a common reference point. A wide range of resistance measurements can be made using internal batteries, separate zero adjustment being provided for each range.

It is of importance to note that this model incorporates the "AVO" automatic cut-out for protection against inadvertent overloads.

Size 8⅛" x 7¼" x 4½"
Weight 6½lbs. (including leads)

£23 : 10s.

For your Valve Characteristic Meter or Valve Tester

Owing to the very large number of valves which have been issued within the last two years, no further amendments will be issued for the original "AVO" Valve Testing Manual. A new, completely revised and fully up-to-date Valve Data Manual is now available from the Company at 15/- post free.

D.C. VOLTAGE	D.C. CURRENT	A.C. VOLTAGE	A.C. CURRENT	RESISTANCE
2·5V.	50μA.	2·5V.	100mA.	*First indication* 0·5Ω.
10V.	250μA.	10V.	1A.	*Maximum indication* 20MΩ.
25V.	1mA.	25V.	2·5A.	0—2,000Ω { using internal batteries.
100V.	10mA.	100V.	10A.	0—200,000Ω { using internal batteries.
250V.	100mA.	250V.	—	0—20MΩ { using internal batteries.
1,000V.	1A.	1,000V.	—	0—200MΩ { using external batteries.
2,500V.	10A.	2,500V.	—	

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO. LTD.
WINDER HOUSE · DOUGLAS STREET · LONDON S.W.1 *Telephone* VICtoria 3404—9

Lister

Start-O-Matic

Diesel Electric Generating Plant

SEND FOR LATEST LITERATURE AND PRICE LISTS OF ALL LISTER GENERATING PLANTS AND WATER PUMPS

2½ kW - - £345
4·5 kW - - £440
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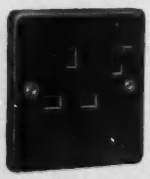
R. A. Lister & Co. Ltd., Dursley, Gloucestershire. *Phone: Dursley 2371*

LONDON : Imperial House, Kingsway Telephone : TEMple Bar 9681 *Also at* STAMFORD, GLASGOW *and* DUBLIN

SETTLE for NETTLE

Nettle Shockproof Electrical Wiring Accessories are being used extensively on schemes large and small. This is because Nettle have for over a quarter of a century specialised exclusively in perfecting the design of all types of shockproof electrical wiring accessories for industrial and domestic installations. In addition to a very wide variety of lampholders, flush and surface type A.C. switches, plugs and socket-outlets, bell transformers, handlamps, weatherproof couplers, rubber-clad weatherproof sockets and plugs, etc., there is a complete range of ring main accessories. Our specialist engineers are available for consultation without obligation.

Ref. ZO 2014. Flush Switch to suit Plaster Depth Boxes. One or two way.



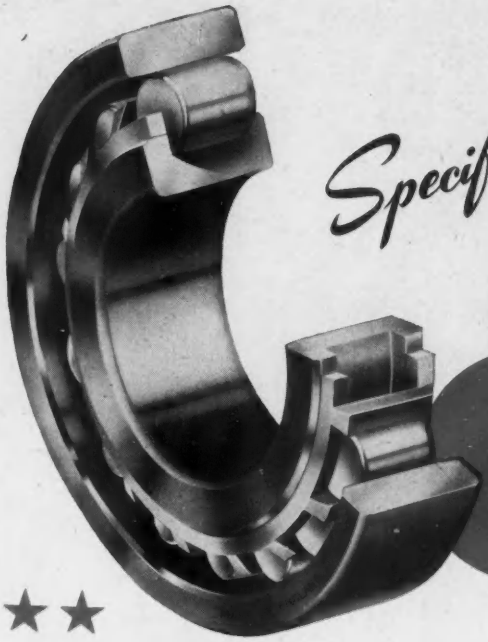
Ref. SF 1230. Switched Socket - outlet, Shuttered Flush Fitting.

Ref. 4. Pendant Lampholder, Porcelain Interior with H.O. Ventilated Skirt.

Ref. Y 73. Combined Plug and Batten Holder, Two or Three Terminal, 2" Screw Centres.

The Nettle Catalogue contains details of the full range of Nettle Shockproof Electrical Accessories. You are invited to write for a copy.

NETTLE ACCESSORIES LTD.
HARPER ROAD · WYTHENSHAWE · MANCHESTER



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BALL & ROLLER R&M BEARINGS

They Save in the long run

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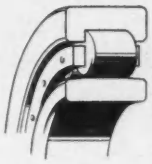
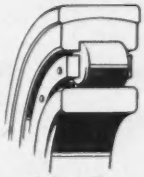
OUR ENGINEERING DEPARTMENT WILL WELCOME THE OPPORTUNITY TO CONSIDER YOUR SPECIFIC APPLICATIONS AND MAKE RECOMMENDATIONS.

ROLLER JOURNALS

By reason of the "line" contact of the rollers with the tracks, roller bearings have, size for size, a considerably increased load carrying capacity as compared with a ball bearing of the same overall dimensions. The accuracy of the rollers and tracking surfaces enables speeds approaching those of ball bearings to be obtained.

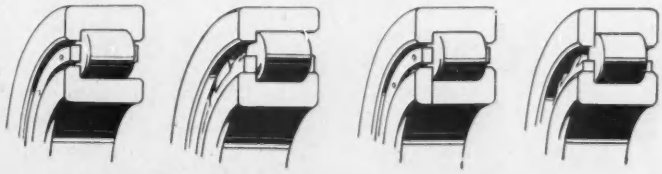


The normal accepted type has a parallel outer ring and shouldered inner ring as shown above, but where conditions demand, bearings are made with a parallel inner ring and shoulders on the outer ring.



When it is necessary for a roller bearing to accommodate misalignment, bearings are supplied fitted with a spherical shell.

Roller bearings are usually required for journal loading only, but under approved conditions bearings made with additional shoulders or sideplates can be employed for location duties. Some of these are here illustrated.



RANSOME & MARLES BEARING CO., LTD., NEWARK-ON-TRENT, ENGLAND

K/RM111

Another home for some lucky family . . . with all mod. con. of course — most of them electric. Depending on good cables—rubber or thermoplastic—developed by members of the Cable Makers Association.

By close technical collaboration among its members, the Cable Makers Association has pioneered the most important developments in electric cable making. That same collaboration makes possible the exceptionally high standards for all types of C.M.A. cable—and safeguards every user.

SPECIFY C·M·A CABLES

STAND C216 B.I.F. BIRMINGHAM

CABLE MAKERS ASSOCIATION, 52/54, HIGH HOLBORN, LONDON, W.C.I.

It might be *(a)* **Sky high maximum temperature = shorter life**

It could be *(b)* **Moderate maximum temperature = longer life**

It should be *(c)* **'Nichrome' temperature + 'Nichrome' life**

It is an established fact that resistance wires of similar basic composition can have different lives under equivalent conditions of working temperature.

The production of a wire giving long life within its admitted range of working temperature can be achieved only by a specialised melting technique and by strict control in the subsequent processing.

These two essential manufacturing characteristics are fundamental, in conception and in practice, to our production of resistance wires for high temperatures. They are factors which can only come from long experience of this exacting work and constant development of technique.

'NICHROME' up to 950° C.	'NICHROME' V up to 1,150° C.

BRITISH DRIVER-HARRIS CO. LTD

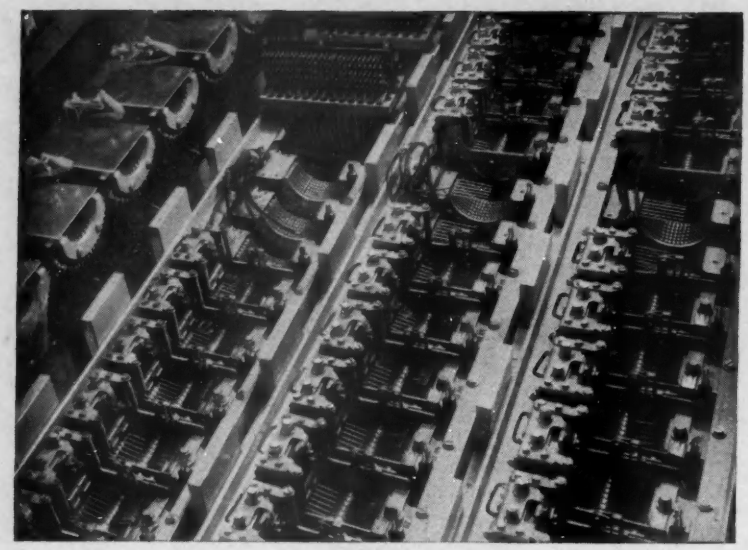
MANCHESTER 15

"NICHROME"

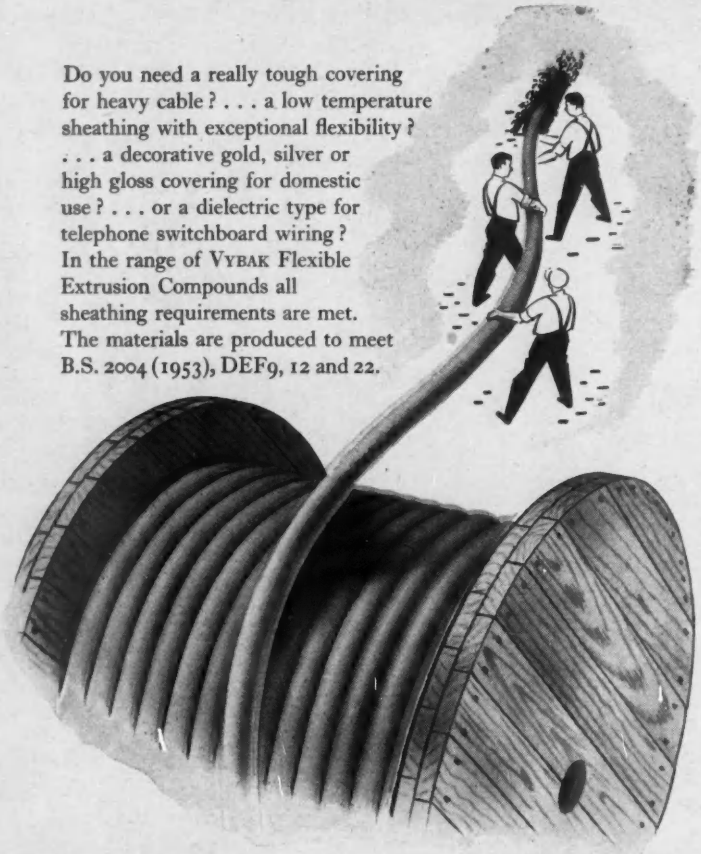
THE GREATEST NAME IN ELECTRICAL RESISTANCE

Nickel and Nickel Alloy Specialists : for furnace elements, domestic appliances, thermo-couples, telecommunications, lamps, spark plugs, fine wires, etc.

Right for every job



Do you need a really tough covering for heavy cable? . . . a low temperature sheathing with exceptional flexibility? . . . a decorative gold, silver or high gloss covering for domestic use? . . . or a dielectric type for telephone switchboard wiring? In the range of VYBAK Flexible Extrusion Compounds all sheathing requirements are met. The materials are produced to meet B.S. 2004 (1953), DEF9, 12 and 22.



BRIEF DATA

Heat Ageing	*outstanding properties*
Weathering	*highly resistant to normal weathering*
Flame Resistance	*VYBAK Plastics will not support combustion.*
Abrasion Resistance	*extremely good*
Flex Life	*test results often exceed a million cycles*
Chemicals	*resistant to alcohol, petrol, oils, solvents and most acids or alkalis*
Colours	*over 150 already being produced*

Comprehensive data sheets for all grades are available on request. Please state your special interest. Rigid extrusion compounds and moulding compounds also supplied.

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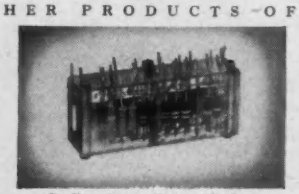
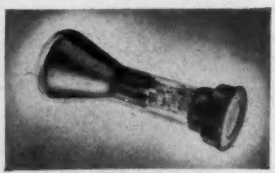
Telephone receiver base in BAKELITE rubber-modified polystyrene material



Radio circuit "potted" in BAKELITE Polyester Resin

BAKELITE Laminated is used for insulation of switches etc.



BAKELITE Cements bond the base to the cathode tube

CB

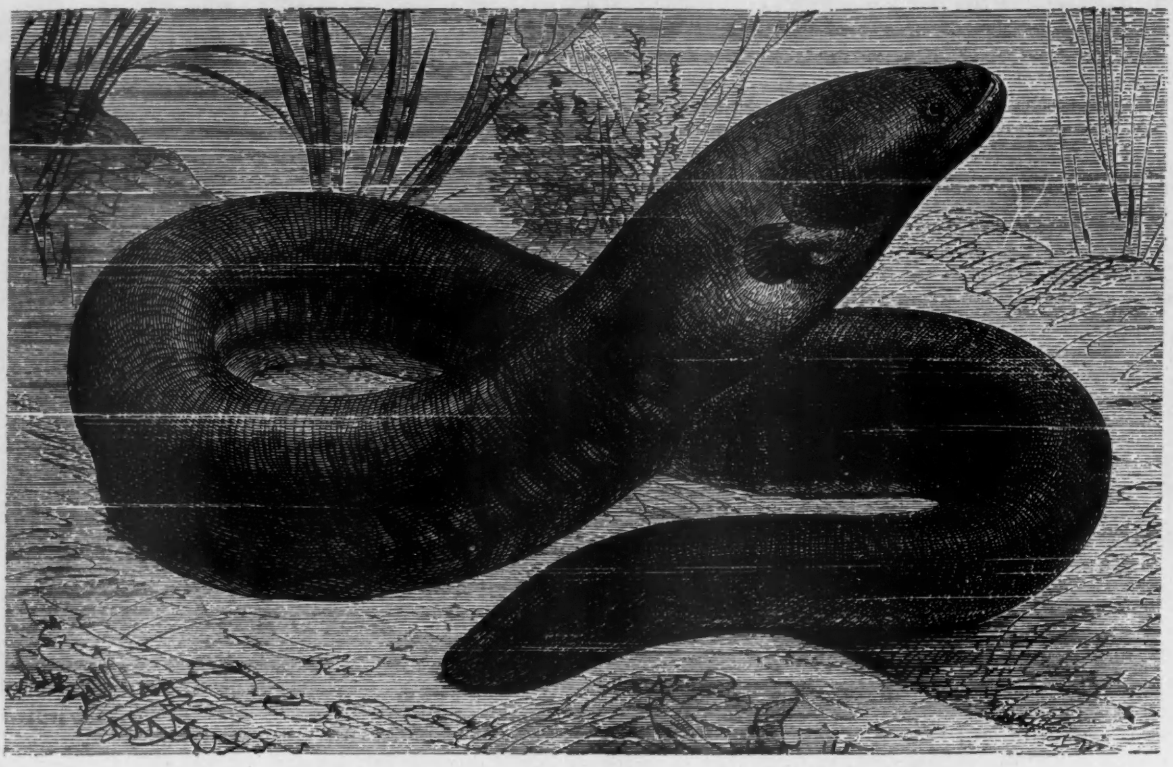
Busy Bees and Bottlenecks

Have you a bee in your bonnet about bottle-necks? Many people have, because they don't use G.E.C. busy bee "Fractionals" to keep things moving and production on the upgrade.

G.E.C. Fractionals

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

How much electricity in an eel's tail?



IN OUR SEVENTY-FIVE YEARS of electrical experience, that is something we have never been asked to measure, which, when we come to think of it, is a little surprising. For every day we are called upon to supply equipment for measuring, generating or utilising electrical energy. And the many users of our products have found that there is a certain additional quality about them which is beyond all measure. That's what we were hinting at when we referred to seventy-five years. Like the eel, we've got a lot of electricity behind us.

When it comes to electrical equipment . . . you've got to hand it to

Crompton Parkinson LIMITED

ELECTRICAL EQUIPMENT

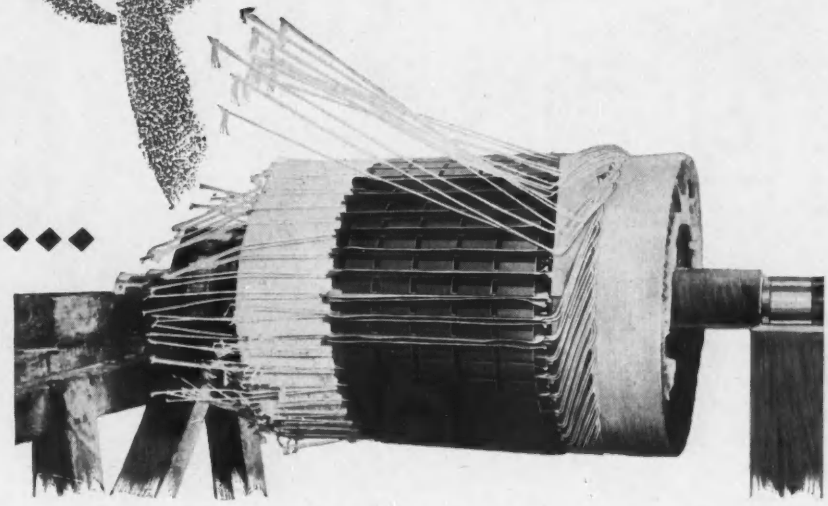
NOTE: Curiously enough, the electric eel (Gymnotus Electricus) is actually a fish. It gives a greater shock than any of the other fishes endowed with electric power. Its electric organs are situated on the back of the tail and along the base and sides of the anal fin. They are capable of giving shocks sufficient to kill other fish and small mammals.

MAKERS OF ELECTRIC MOTORS OF ALL KINDS · ALTERNATORS GENERATORS · SWITCHGEAR · B.E.T. TRANSFORMERS · CABLES INSTRUMENTS · LAMPS · LIGHTING EQUIPMENT · BATTERIES STUD WELDING EQUIPMENT · TRACTION EQUIPMENT

CROMPTON PARKINSON LIMITED · CROMPTON HOUSE · ALDWYCH · LONDON · W.C.2 · TELEPHONE: CHANCERY 3333

REWINDING...

& REPAIRS...



The extensive winding and repair departments cater for all types of electrical plant and machines up to about 2,000 horse-power and transformers of ratings up to 500 Kva. Long experience and modern production methods ensure a reliable and outstanding service.

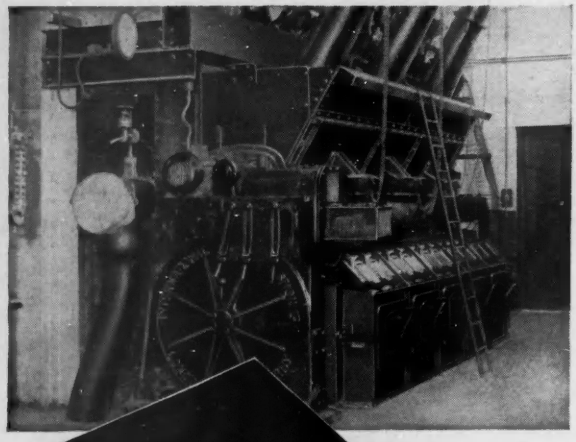
BROWNING'S ELECTRIC CO LTD

BOLEYN CASTLE, GREEN STREET, UPTON PARK, LONDON, E.13 Tel: GRA 4003 (4 lines)

In power stations

Firing aisle showing twin 'L' stokers at an Electricity Generating Station.

Small 'L' stoker installation at a Chemical Works.



and in factories

ICL ENTERPRISING ENGINEERING

Saves coal

INTERNATIONAL COMBUSTION LIMITED

LONDON OFFICE: NINETEEN WOBURN PLACE, W.C.1. WORKS: DERBY, ENGLAND; PORT ELIZABETH, SOUTH AFRICA; SYDNEY, AUSTRALIA

Tomorrow's insulator . . .

here today!

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ALL THE ADVANTAGES OF

PERMALI

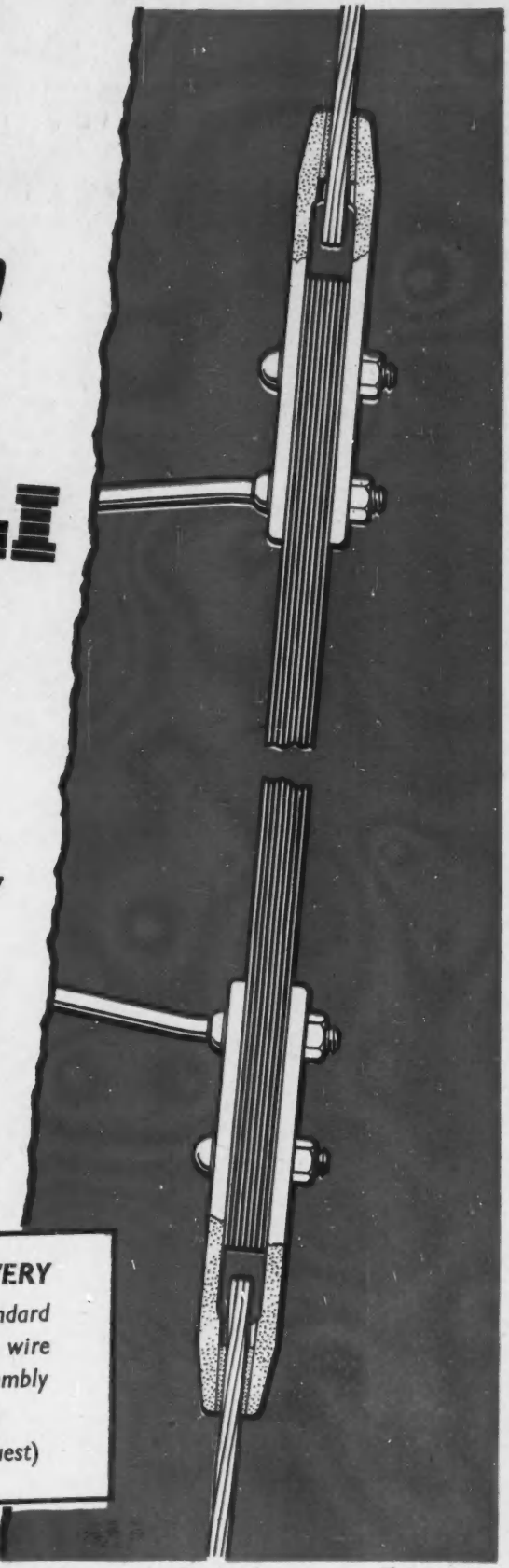
STAY WIRE INSULATORS

- Absolute Reliability
- High impulse protection
- Weatherproof
- 1/5th weight of natural timber insulator

Plus those of the new

C stay-rod fitting

- Complete elimination of splicing—
- 18" to 24" of wire SAVED on every insulator
- Faster erection—lower costs



Cable Covers Limited have appointed Permali Ltd. as sole agents for the supply of C.C.L. end fittings for Staywire Insulators to B.S.1320.

***IMMEDIATE DELIVERY EX STOCK** of standard insulators for 7/8 S.W.G. wire U.B.S. of whole assembly*
GUARANTEED
(Test certificate on request)

All enquiries to:-

PERMALI LIMITED Gloucester England · Tel: 24941

BRITISH STANDARD DIMENSION MOTORS

by

B T-H

DELIVERY FROM STOCK

British Thomson-Houston were among the first to manufacture mechanically-interchangeable motors conforming to British Standard 2083. A number of manufacturers now produce machines to this specification, but the BTH range of totally-enclosed fan-cooled squirrel-cage motors up to 20 h.p. have mechanical and electrical characteristics that are unsurpassed.

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

Member of the AEI group of companies

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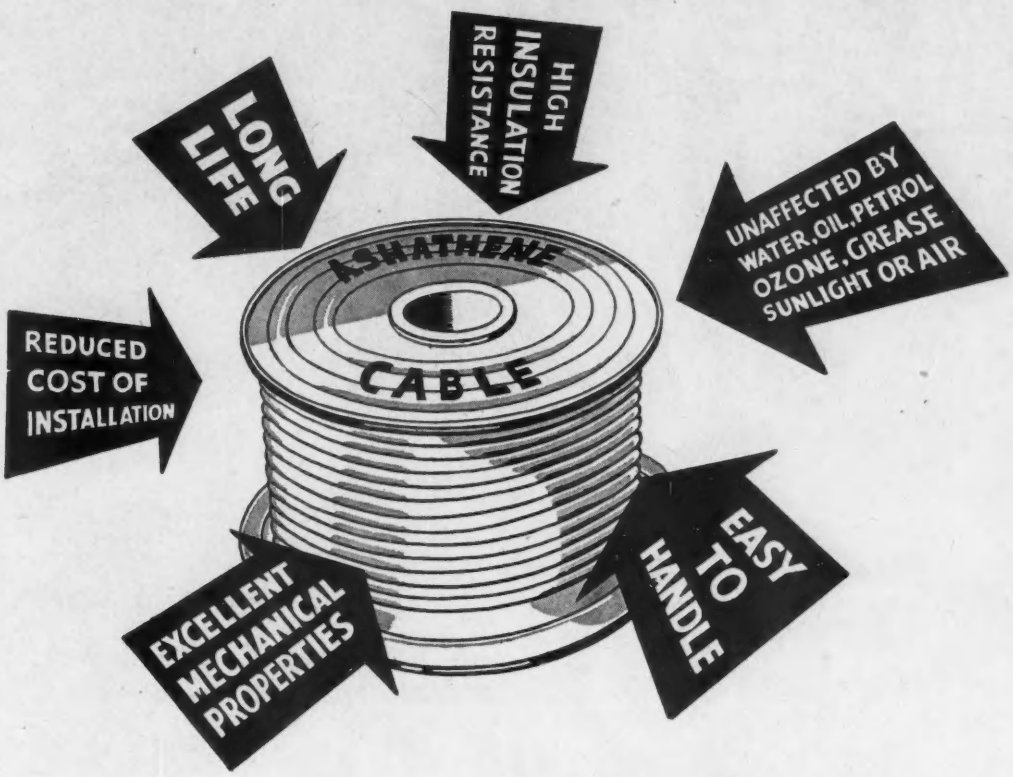
.From every angle



Ashathene is manufactured in all standard sizes and is also available in S.W.A. & D.W.A. classes. Please send for leaflet TL/1001 and price details.

Ashathene provides the answer to an efficient and labour saving electrical wiring in the home and factory. Made to a very high standard, Ashathene is a better cable electrically and mechanically at a lower cost.

Features of Ashathene are:—

HIGH DIELECTRIC—Polythene insulated cores have a measured insulation resistance more than 100 times that of similar rubber insulated material.

HIGH VOLTAGE INSULATION—High voltage tests on Ashathene Cable show a factor of safety 1·6 times greater than the equivalent rubber insulation on the same size of cable.

FIRE RESISTING QUALITIES—The P.V.C. used on the sheathing of Ashathene will not support or spread a flame and, unlike rubber, is self extinguishing when the flame is removed.

MECHANICAL QUALITIES—Ashathene is a tough flexible cable which is unaffected by climatic conditions. It is manufactured to give long and trouble-free service. Compared with rubber, polythene insulated conductors will withstand over twice the mechanical pressure without an electrical failure occurring.

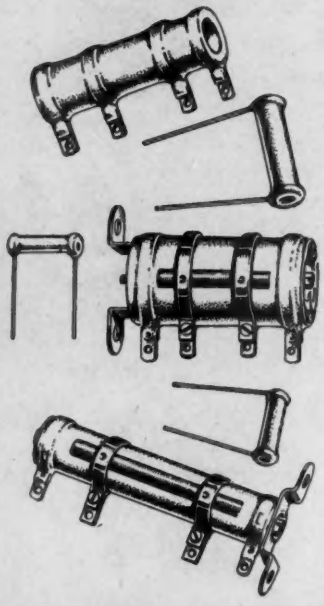
ASHATHENE

THERMOPLASTIC INSULATED CABLES

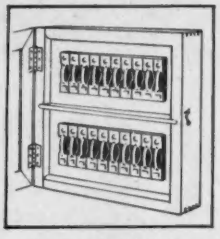
AERIALITE LTD, CASTLE WORKS · STALYBRIDGE · CHESHIRE

WIRE WOUND RESISTORS

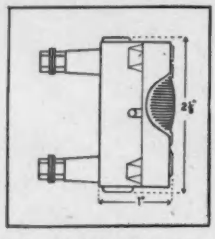
C.R.M. resistors are wound on high grade low loss ceramic tubes. They can be coated with — Silicone Resins — Vitreous enamel or Cement with terminations to suit customers requirements.
C.R.M. resistors have a low temperature Co-efficient of resistance, are of robust construction and can be used under conditions where reliability and stability are important factors.
Good delivery — Low prices.
We shall be pleased to quote for your requirements.



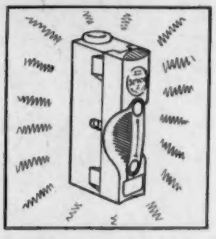
COMMERCIAL RESISTOR MFG. Co. LTD.
MARSH ROAD, PITSEA, ESSEX
Telephone: VANGE 2[illegible]



MINIMUM DIMENSIONS



EASE OF MOUNTING AND WIRING



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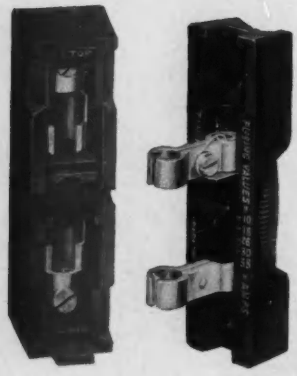
To simplify and protect . . .

Slydlok 5 amp 250 volt fuses afford the designer complete freedom because their ease of wiring, their compactness, and above all their resistance to mechanical shock, enables them to be incorporated wherever convenient. Adaptable for cartridge fuses and neutral links, Slydlok afford protection with simplicity. Write for literature.



SLYDLOK FUSES

EDWARD Wilcox & CO. LTD., WYTHENSHAWE MANCHESTER
Tel: WYThenshawe 2235/6/7 Grams: Slydlox, Manchester

dm EW 54

BROOK Introduce a Smaller "Fractional"

Good news for users of small motors

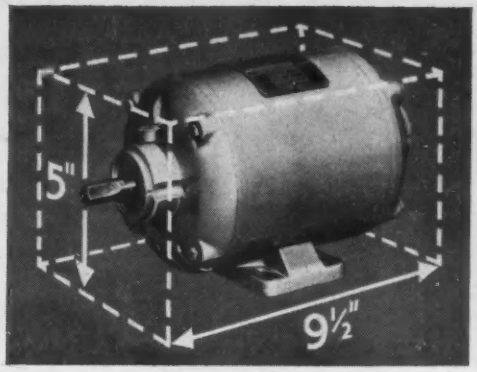
OUTPUTS

THREE PHASE SUPPLY

FRAME SIZE	PROTECTED H.P. AT SYN. SPEEDS			TOTALLY ENCLOSED H.P. AT SYN. SPEEDS		
	3000	1500	1000	3000	1500	1000
BS42	1RD/3	1TH/4	1TH/8	1TH/6	1TH/8	1TH/16

SINGLE PHASE SUPPLY

FRAME SIZE	PROTECTED H.P. AT SYN. SPEEDS			TOTALLY ENCLOSED H.P. AT SYN. SPEEDS		
	3000	1500	1000	3000	1500	1000
BS42	1TH/6	1TH/8	1TH/16	1TH/10	1TH/12	1TH/25



The B.S. 42.

Produced by special request this small motor built to 'big motor' standards of sturdiness and power output will find many uses for footwear, office or packaging machines and similar applications.

•

Available also in flange mounting and face mounting types.

•

WRITE FOR DETAILED LIST

1904 BROOK MOTORS LTD 1954

HUDDERSFIELD • ENGLAND

BIF 8-14 May CASTLE BROMWICH BIRMINGHAM SEE OUR EXHIBIT STAND No. C304

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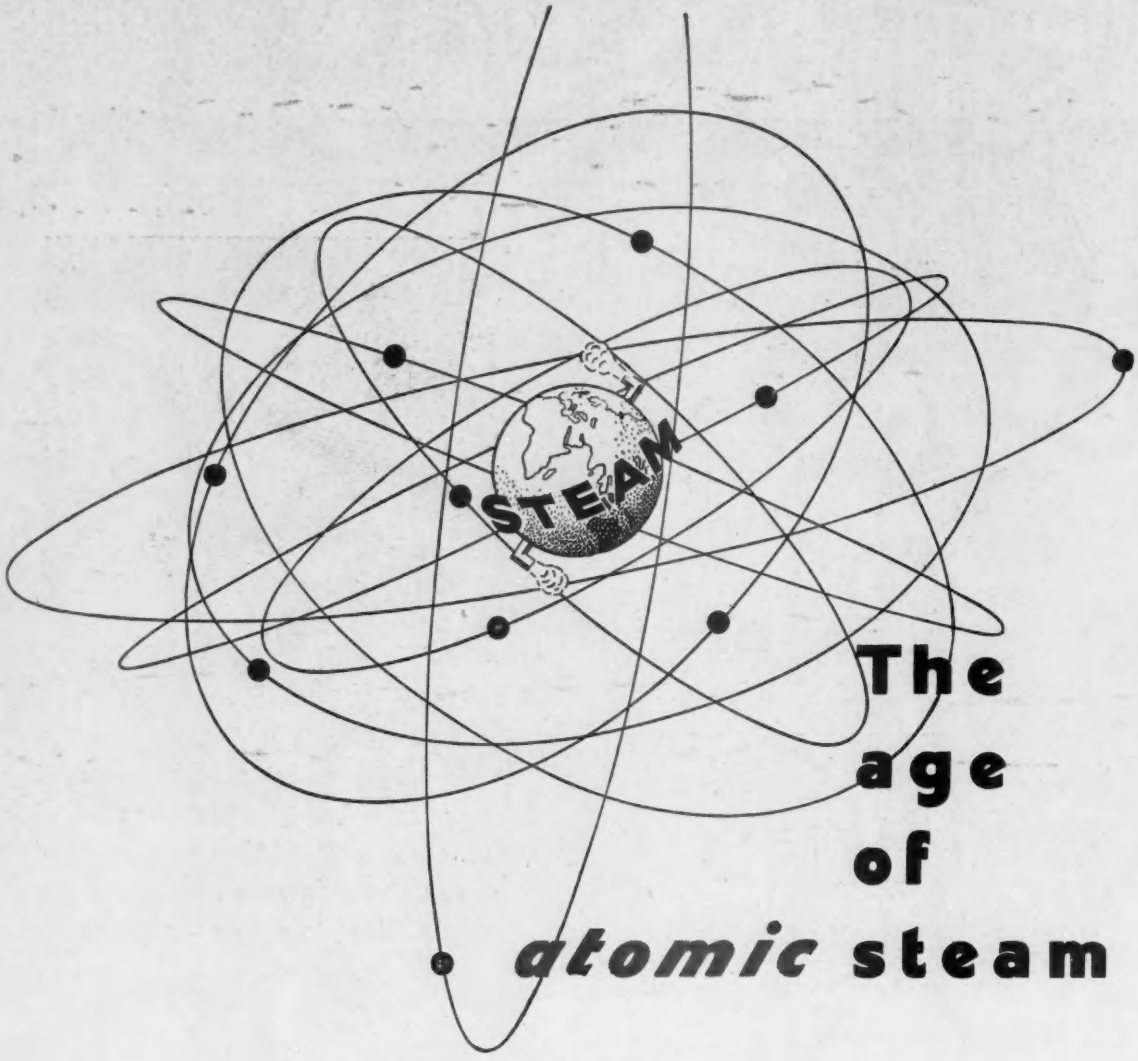


The age of *atomic* steam

Atomic energy as a controlled source of industrial power will become available through the medium of *steam* generated by the "burning" of atomic fuel instead of coal or oil.

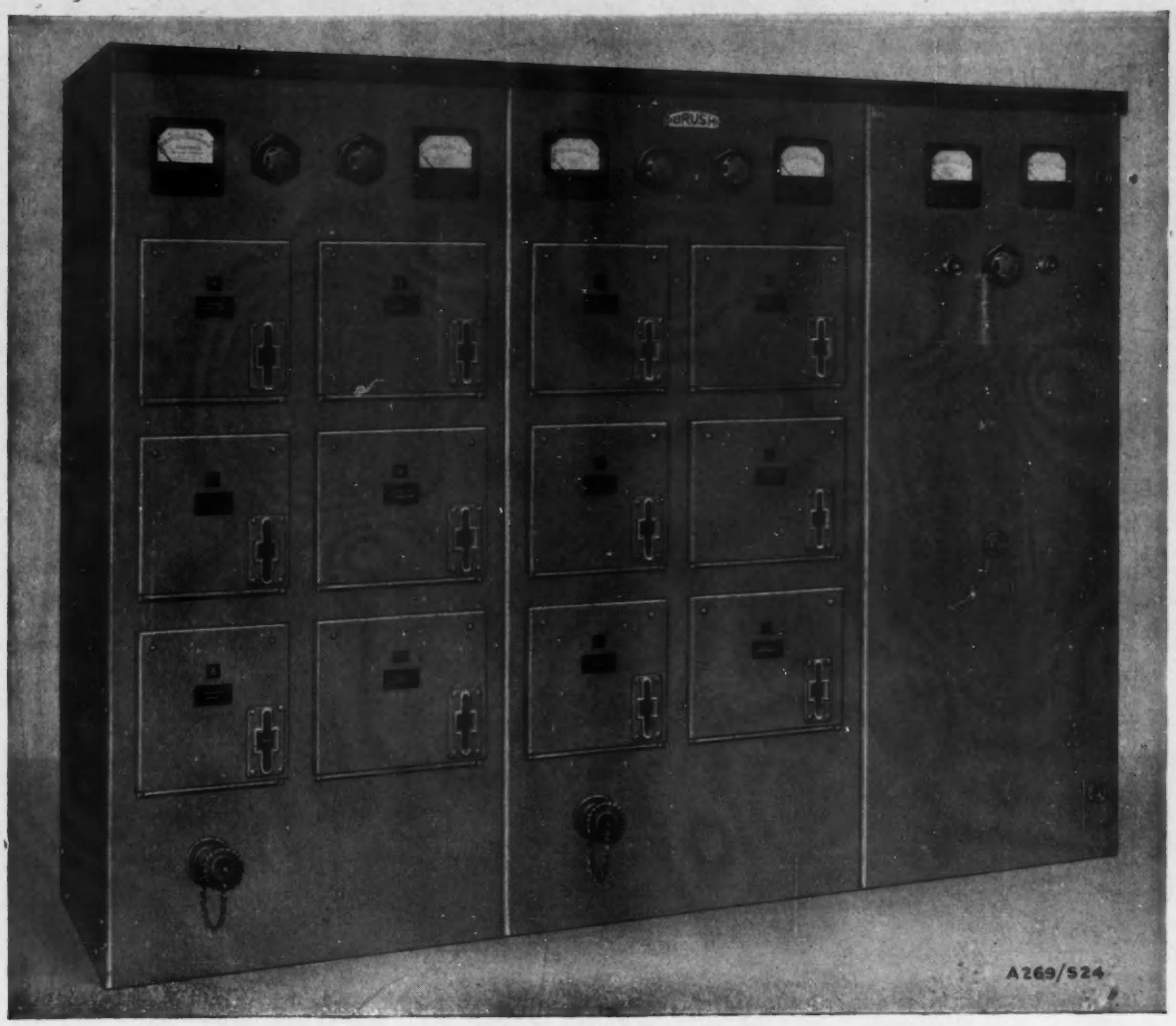
Babcock & Wilcox, as the world's leading steam engineers, are playing a prominent rôle in this development; and the generators of **the first atomic electric power station** now being built at Calder Hall will be driven by *steam*, generated in steam-raising plant jointly designed by Babcock & Wilcox and the Department of Atomic Energy, and manufactured by Babcock & Wilcox.

It is typical of the forward outlook of this Company, which has supplied the steam plant of nearly half our power stations, that, while continually developing new and better means of using the world's conventional fuel resources, it is also actively concerned with the industrial applications of atomic energy.

BABCOCK

STEAM-RAISING PLANT

BABCOCK & WILCOX LTD., BABCOCK HOUSE, FARRINGDON STREET, LONDON, E.C.4



Space-saving switchboards

Brush A.F. type distribution gear is specially designed to save both valuable floor space and the expense of installing circuit breakers on each individual circuit. Design is neat and compact; high rupturing capacity fuse switches are employed on individual outlets, with automatic circuit breakers on the primary circuits only. All parts are easily accessible for maintenance and fuse removal. Brush A.F. type distribution gear is available for A.C. circuits up to 600 volts. Publication No. 41050 gives the full specification.

Switchgear by BRUSH

THE BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH, ENGLAND

Birmingham · Bristol · Cardiff · Glasgow · Ipswich · Leeds · London · Manchester · Newcastle · Sheffield

B28

Another Hoover Half-Page in the DAILY EXPRESS

(Daily net sales more than 4,000,000)

Appearing 22nd April

Spring clean the HOOVER way!
-IT'S SO MUCH EASIER
CLEANS THE WHOLE HOUSE THOROUGHLY
FROM TOP
TO BOTTOM
The magnificent Hoover Standard Cleaner equipped with full range of cleaning tools.
The world-famous Hoover Junior — also equipped with cleaning tools.
The Hoover Standard Cleaner in use with one of the cleaning tools.
See this exclusive feature
Yes, now's the time to get your Hoover Cleaner — ready for spring cleaning. It's just marvellous the difference it makes! So much easier! And quicker! And everything spotlessly clean from top to bottom.
With one of the latest Hoover Cleaners and its marvellous range of cleaning tools you can do the whole job in a fraction of the time it takes you now — far more thoroughly than any other cleaner — and without having to turn the whole place upside down! See your Hoover Dealer or post coupon for 2 days Free Loan NOW!
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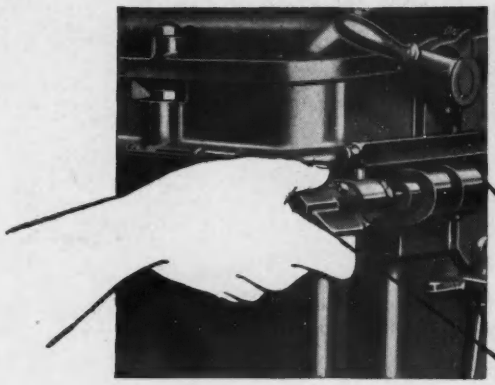

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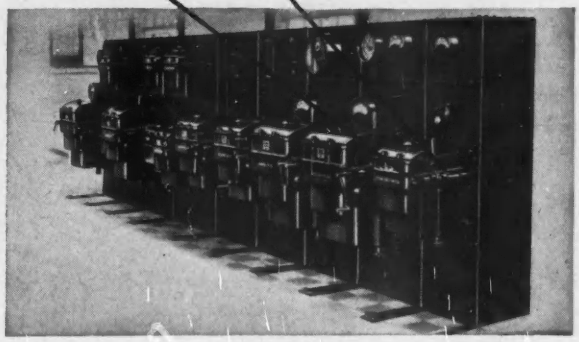

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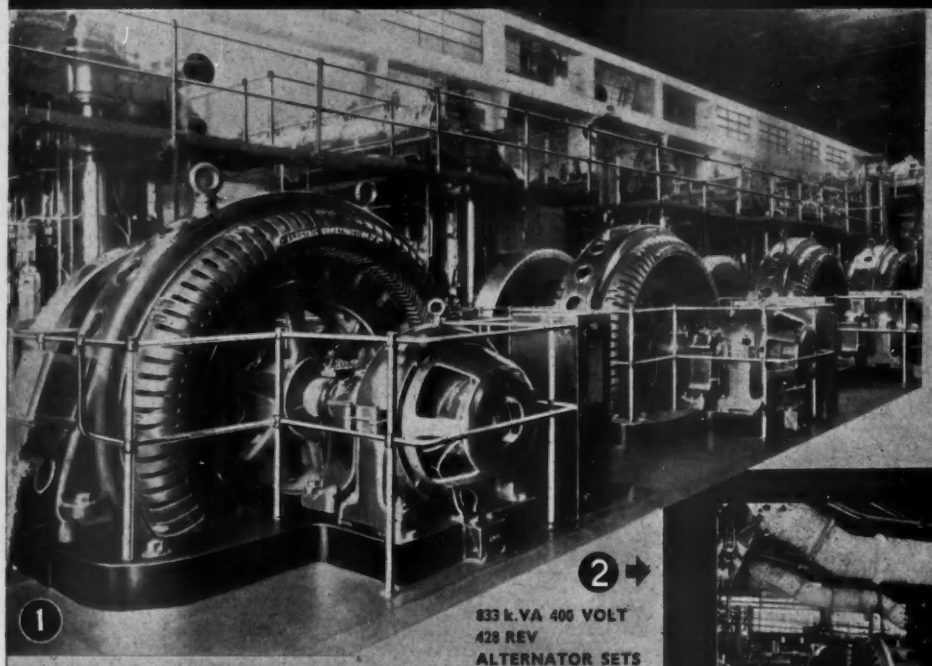
ENGINE-DRIVEN ALTERNATORS



1

← 1

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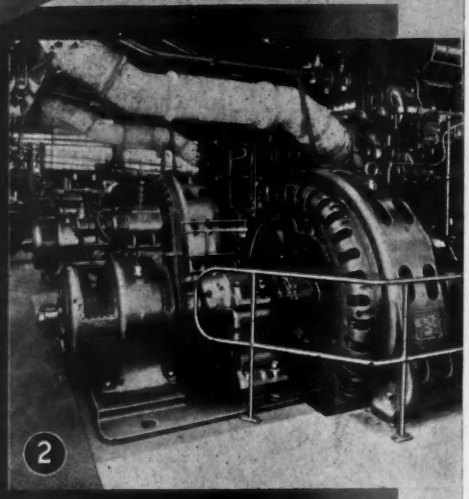
2 →

833 k.VA 400 VOLT 428 REV ALTERNATOR SETS OPERATING IN THE POWER HOUSE AT THE WORKS OF MESSRS. BLACKSTONE & COMPANY LTD.

Brochure B1720 "ECC ALTERNATORS" Available on request



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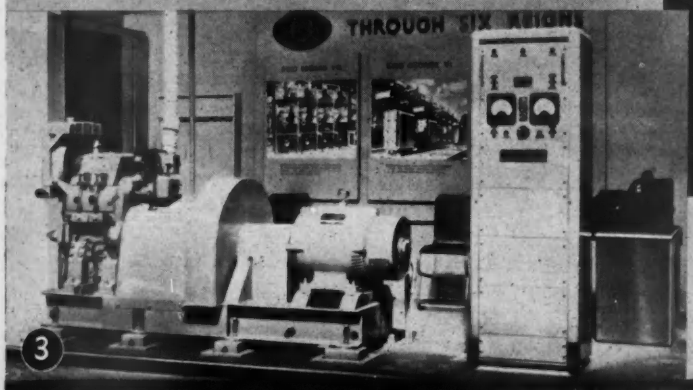

3

← 3

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ESTABLISHED 1882

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Head Office and Works: BUSHBURY ENGINEERING WORKS WOLVERHAMPTON ENGLAND

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TIME FOR REWIRING ?

Since E.D.A. has been permitted to promote domestic electrification effectively once more, its efforts have been concentrated on selling more of the attractive load-factor improving appliances, cookers, water-heaters, refrigerators and washing machines. The 1954 advertising programme is to follow the same main theme; but this scheme needs the corollary of promotion of the many smaller electrical appliances, and of lighting. Should E.D.A., then, plan for a full scale adequate wiring campaign in 1955 or soon after? The suggestion on these lines put forward at the E.D.A. Conference during its meetings last week deserves wide consideration in the industry. There is appalling ignorance on the subject of adequate wiring: the infamous suggestion of the Ministry of Housing's Committee on House Interiors is recent evidence enough of this: "Whatever system is adopted, it is important that the number of light and power points per house should be kept to a minimum." Adequate wiring, and, perhaps rewiring, is a theme worth pressing. The only question is, when?

E.D.A. RESURGENT

Nineteen fifty-three was a good year for electricity, with many of the unsought bonds imposed on the industry by wartime restrictions at last sloughed off; and a welcome air of freedom regained breathes through each page of the Electrical Development Association's report for the year. Apart from the artificial absence of any recognition that gas and solid fuel competitors exist—a reticence Governmentally imposed in print and talk, though not in understanding and action—E.D.A. is back on its rightful job of selling more electricity. Yet there are many facets to this task, and perhaps the most significant section of the report is that dealing with an apparently non-promotional activity, the Testing House and the joint B.S.I./E.D.A. Advisory Committee on Appliances and Accessories. This post-war development of E.D.A.'s work advanced markedly during 1953, with the Testing House becoming fully operative, and it is now exercising an important influence on the design of electrical appliances. This is in itself an impressive recognition of the importance of electricity showrooms as selling centres, for it is in this respect that supply industry approval directly affects the manufacturer. Yet even in this activity, E.D.A. manages to extract some promotional advantage. The work has made it relatively simple to prepare quickly, reliable lists of appliances which the Ministry of Fuel and Power can identify to local housing authorities as "approved," with all the selling power that the term carries.

The resurgence of E.D.A. promises some excitement before 1954 is out, and a taste of aggressiveness that is especially sweet for being absent overlong.

BUDGET BOOST FOR PLANT

For the electrical industry as for most others, the Budget proposals are unlikely to produce many immediate alterations in trading experience. With the "as you were" already pronounced for purchase tax, this was inevitable, and the extension of this order merely confirmed the point. However, taking the longer view, the one notable change that Mr Butler proposed, the substitution of investment allowances for the present initial allowances, is likely to have some significance for the industry. For the supply industry it will do away with the avowed reason for the B.E.A.'s taxation reserve, and so swell the future surpluses of area boards. Moreover, if it proves successful as an incentive for private manufacturing industry to increase its capital expenditure, then since new plant means electrically operated plant today, all sections of the industry should benefit. This will again affect the supply industry, for in the absence of any radical rearrangement of industrial methods, the resulting additional industrial load is unlikely to help improve the load factor, and proportionately more generating capacity will be required. The necessary corollary, then, of this official encouragement of new investment, is permission for the B.E.A. to step up its rate of annual commissioning to the level experience shows to be advisable, without an artificial limit imposed on vague economic grounds; and for the expansion of domestic electrification as well, to keep filled the resultant load valleys.

TOO MUCH TENDERING

Open advertisement of contracts, followed by competitive tendering is an old established practice that has much to recommend it as a means of securing effective competition, especially in the building industry. Yet it is undeniably expensive to the ultimate customer, since the preparation of tenders is a costly procedure, and successes must pay for the more frequent failures. There are good grounds to support, therefore, a strong recommendation made by an authoritative committee of architects, surveyors and builders, that greater use should be made of the principles of selective tendering, whereby only a limited number of offers to submit tenders are accepted; enough to secure effective competition, but no more. Although the committee, which had the blessing of the Ministry of Works, was principally concerned with the main contractors in building projects, if its recommendations are widely accepted, they cannot fail to influence electrical contracting. Work for local authorities especially will be affected, for these bodies have shown themselves rigidly attached to open tendering, even for small jobs. This often poses some awkward problems for the reputable electrical contractor. He must either spend considerable time on preparing a realistic tender, knowing that he may be undercut by a competitor whose work may not be of the same standard or else guess, and risk a loss in order to keep on the "interested" list so far as the authority is concerned. If the contractor knows that he is up against only four or five firms of his own class, then the work of estimating and tendering becomes more attractive, yet the interests of the customer are still protected. The system may perhaps delay the development of up and coming firms whose worth is not yet proved, but efficient administration and frequent reviews of invited firms can prevent this becoming serious.

INDUSTRY MOVES IN ON THE ATOM

Recent months have seen a number of significant advances towards the use of nuclear energy for power supply purposes. One of the less spectacular signs of this has come from company chairmen's addresses. At last the electrical and allied manufacturing industry is moving in on the atom. Two years ago, the general feeling was that development could be left to the Government, but as practical day to day applications of nuclear reactors become more imminent industry feels the need for a share in developments. To quote from one recent speech "... we are watching these developments alertly, and our research and design engineers are ready to take an active part in the solution of the many problems associated with this form of energy." The first chance of effective co-operation between manufacturers and official researchers has come with the plants now being built in Cumberland and Scotland. Although for the early establishments the electrical generating side of the reactor stations is unlikely to present any novel problems, and the steam side is largely a heat exchanger question, there may be more complicated projects on the way, while special requirements are unlikely to be absent even in the early experiments. Indeed, in the design of the reactors themselves, electrical skills are nearly as important as those of chemical engineering, and there should be an opportunity for some fruitful partnerships between firms in these fields, with as always, the prize of rewarding exports in the foreseeable future.

STANDARD SYMBOLS

V, A and Ω ; those of us who are electrical engineers recognise these familiar symbols readily enough. Faced with ϕ we are less certain; entropy or angle? S is likely to floor us completely unless professional necessity has made us familiar with this alternative for entropy which the physicist prefers. It is preferred, too, in a new British Standard which attempts to bring a higher degree of standardisation to the use of abbrevariations and symbols, by replacing the differing practices of scientists and engineers by one common list This is an ambitious project, but from Part 1 of the Standard, all that is so far available, the work seems to have been thoroughly carried out. Its result certainly emphasises the necessity of some agreement on common practice. The 26 letters of our alphabet support no less than 160 meanings, even if their use as direct abbreviations is left out of the count. The 24 letter Greek is only less prolific, with nearly 100 meanings that make the scientist familiar with the appearance of a language he cannot construe. With engineering as the meeting point of so many branches of scientific study, the new standard cannot fail to be welcome, at the lowest estimate, as a convenient arbiter of method. But it may be valuable beyond this, in adding even slightly to the ease with which discoveries may be propagated and theories noised abroad.

Meteor

The Manufacture of Aluminium Wire and Rod

PORT TENNANT PLANT USES SEMI-CONTINUOUS MILL LINE WITH AN OUTPUT OF 30,000 TONS PER ANNUM

AT the end of 1946, the Aluminium Wire and Cable Co., Ltd., was formed as a joint venture by the British Aluminium Co., Tube Investments Ltd. and the Hawker Siddeley Group Ltd. The primary reason for the formation of the new company was the increased demand for all-aluminium conductor, steel-cored aluminium conductor, and aluminium alloy conductor (Simalec), for overhead transmission and distribution of electricity. There was also a requirement for aluminium rod and wire for general engineering purposes. The three participating companies, one of which (the British Aluminium Co., Ltd.) had been engaged in manufacture of these products for nearly 50 years, accordingly transferred all their interests in aluminium wire and rod to the new company.

The works are located at Port Tennant, and the main shop of the factory, housing the new semi-continuous mill for rolling hot-rolled rod is over 900 ft long. A nearby site of some 60 acres, has recently been acquired by the company for further extension of manufacturing facilities in the future.

The Semi-Continuous Mill

In 1952 the Company installed a semi-continuous mill for the production of hot-rolled rod. This mill, comprises a 3-high 21 in. roughing mill, a 16 in. intermediate mill, and seven in-line finishing mills. At the end of the line, the finished rod is fed on to two automatic coilers.

Material is fed into the mill in the form of pre-heated wirebars, 9 ft long by 4 in. square, each bar weighing approximately 150 lb. The heating is carried out in electric re-heating furnaces. After passing through the mill, the aluminium appears as rod in three standard sizes of $\frac{1}{2}$ in., $\frac{7}{16}$ in., and $\frac{1}{4}$ in. dia. With an operating capacity of 6 tons/hr or approximately 30,000 tons per year, the mill is one of the most modern of its type in the world.

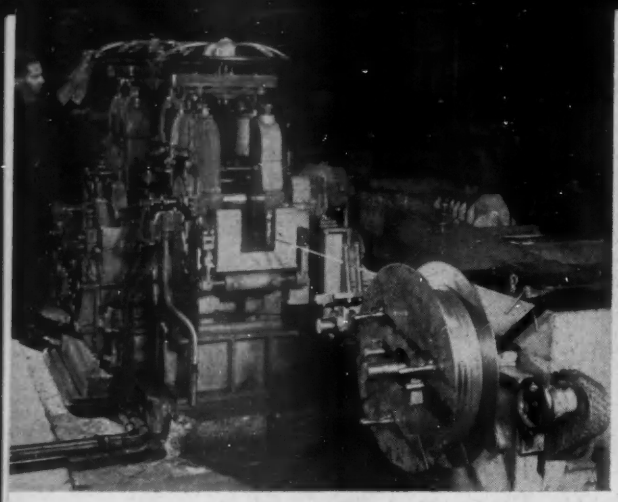
The initial preheating of the bars is carried out in three 620 kW electric furnaces of the chain conveyor forced air circulation type, specially constructed by the Electric Resistance Furnace Co., Ltd. Each one of the furnaces has a capacity of about two tons per hour, and is provided with Foster Instrument Co. fully automatic temperature and overload control. Maximum temperature of the furnaces is 600° C., but this is seldom needed. For most forms of wire-bar, a temperature of about 400° C. is sufficient although for alloys a higher figure of about 450 °C. may be required. Electrically powered fork trucks are used to transport the wire-bars from the stock-area to the furnaces.

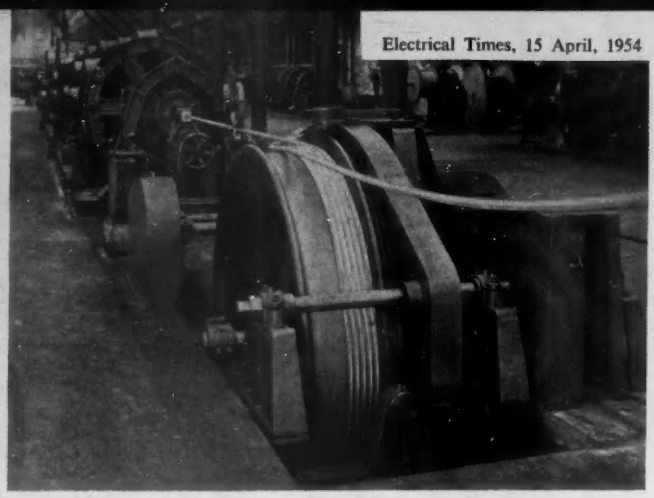
After passing through the furnaces, a process which takes approximately three hours, the bars are ready for the first section of the mill, which consists of a 3-high 21 in. roughing mill. The bar is handled in this mill by hinged trough type manipulators which after each pass position it ready for the following pass. For normal production of $\frac{1}{2}$ in. dia. aluminium rod (the standard size of the aluminium industry) there are seven passes at this mill. Pneumatic rams are extensively utilised to drive the bars into the mill. The main drive is provided by a 500 h.p., 6·6 kV English Electric induction motor.

Following the roughing mill, is the intermediate mill. Here the bar is manipulated by guides which swing the leading end of the outgoing bar round into the next pass, the following length being allowed to swing out on to a series of radial rollers which accommodate the increase in length as it is reduced in the mill rollers. Prior to entering this mill the nose of the rod is automatically cropped. Five passes are taken, and the aluminium emerges in the form of a flat bar, and travels down a long run out table before entering the finishing mills. The intermediate mill consists of two 16 in. automatic looping mills in tandem and is powered by a 750 h.p., 6·6 kV E.E. induction motor.

Finishing is carried out by a series of seven independently driven mills in the finishing train. Four of these are hori-

Above is a view of the mill line looking on the input side of the roughing mill, in the foreground





Left is one of the flattening machines for making strip, and right the output end of a 54-bobbin stranding machine

zontal and three vertical, being arranged so that the first and last units are horizontal. All the drives are by 150 h.p. d.c. motors which derive their power from a Ward Leonard set consisting of a 1,100 h.p. synchronous 6·6 kV E.E. motor driving a 700 kW, 400 V, d.c. generator. The motors are geared to the mills through gear trains which provide the mill rolls with the approximately correct speed, final speed trimming being carried out by adjustment of the motor speed. Once the correct speed ratios of the seven units have been established, the speed of the whole mill can be raised or lowered by a master control. An unusual feature is that due to the closeness of the mills, no looping of the wire is permitted, the speeds of the units being so adjusted that the wire remains in tension between each stand.

Another feature, of considerable interest, is that the rolls are grooved for the whole of their length, and when one groove is showing signs of wear, the complete stand can be moved horizontally across the guides (in the case of the horizontal stands) or vertically (in the case of the remainder) to bring a new groove in register with the guides. The drives are through sliding couplings which can take up this movement. This process is carried out by auxiliary motors, and is both time-saving and convenient.

Before entering the finishing train, the ends of the bar are cropped to ensure the absence of any nose or tail defect which might result in a subsequent fault in the finished rod. The provision of alternate horizontal and vertical rolls, is to obviate the requirement for twisting the bar between stands, and the consequent risk of damage is completely avoided.

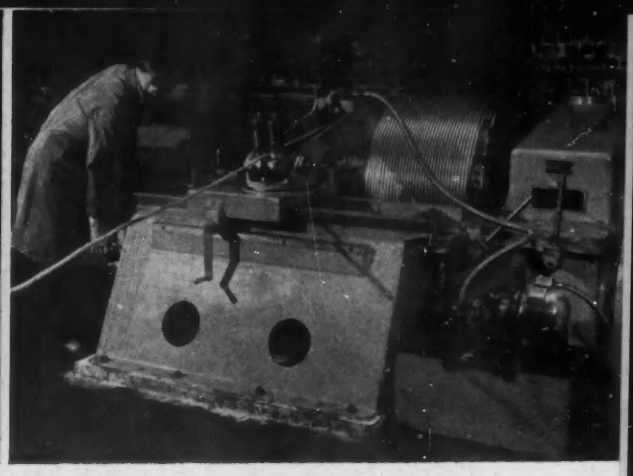
Finally, the emerging rod, which is by now moving at a speed of some 3,000 ft per minute, is fed to twin automatic coilers, from which it is transferred to a slat conveyor passing subsequently to an automatic overhead conveyor for automatic weighing and inspection prior to wiredrawing or storage. The mill operation is controlled either manually or automatically from three pulpits, one covering the furnace conveyor and extractor mechanism, one the 21 in. and 16 in. mills, and one the finishing train and coilers.

Wiredrawing Plant

The wiredrawing plant consists of a complete range of machines, from heavy duty breaking down units capable of producing wire of ¼ in. dia. and over, down to fine wire machines capable of producing 39 s.w.g. (·0052 in. dia.). In selecting the plant, particular account was taken of quality of product, versatility and economy of operation and maintenance. The majority of the machines were supplied by Marshall Richards Machine Co., Ltd., in many cases to designs worked out jointly by the suppliers and the Company's engineers. Machines by other well known manufacturers are also installed—W. H. A. Robertson and Co., Ltd., Sir James Farmer Norton and Co., Ltd., and Bartin Ltd.

Apart from a few single bull-blocks for special breaking down work, or for the production of the thicker sizes of strong alloy wire, all the machines are multi-die and designed for high speeds. These are of both slip and non-slip types and have 3, 5, 7, 9 and 11 dies. Power for these machines is in general derived from mercury arc rectifiers located near the machines. The motors for the successive drawing heads are individually speed controlled, and again over-riding

One of the special die-polishing machines in the die maintenance section of the works



An 11-die drawing machine is shown on the left, and one of the heavy machines for large sizes on the right

control is provided in some cases by the use of grid control on the rectifiers.

The machines are either continuous, or, in the case of those designed for intermediate sizes of wire, of the accumulation type. Speeds range from 1,500 ft per minute on the older machines to 3,000 ft per minute on the newer plant. When drawing the finest wire, speeds up to 4,000 ft per minute may be attained. The wire can be taken up on standard blocks giving a finished coil, or on special reels which are subsequently transferred to the stranding machines for the manufacture of conductor. Fine wire down to ·010 in. dia. can be supplied either in coil or on reels, but below this diameter is supplied on reels only.

Two specially designed heavy duty machines have been installed for the production of large diameter rivet or other stock in any aluminium alloy, up to 1 in. dia. in anticipation of the increased demand as the use of aluminium develops for constructional purposes. The basic stock for this work does not come from the semi-continuous rod mill but can be produced in the works if necessary on an old, but most competent hand mill, which, although once steam driven, has now been converted to operate on an electrical drive.

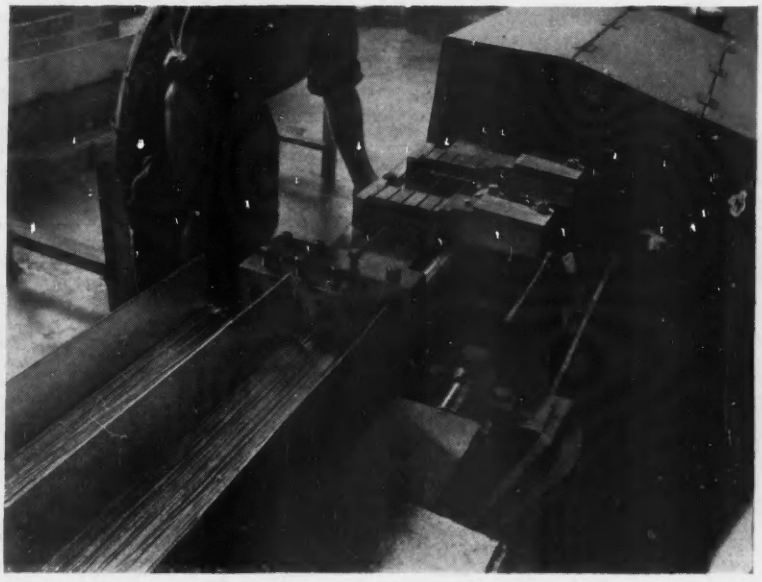
Dies

The dies used in the drawing of aluminium are of tungsten carbide shrunk into steel holders, except for the smallest sizes of wire where diamond dies are essential. As the production of a high quality, accurate and consistent gauge of wire depends fundamentally on the dies, a fully equipped die maintenance department has been set up with a complete range of modern equipment for the accurate servicing and inspection of all classes of wire-drawing work. As dies wear, they are trued and repolished until the "parallel" section of the die reaches a certain minimum length. When this happens, the die is opened out to the next larger required size and recommences a further tour of duty. Final polishing is at the moment being carried out by hand, but a new machine now being completed will, it is hoped, reduce the time for this laborious process. The reason for hand-polishing is mainly due to expense of the diamond paste used in the process, and hand work is the most sparing of this expensive item.

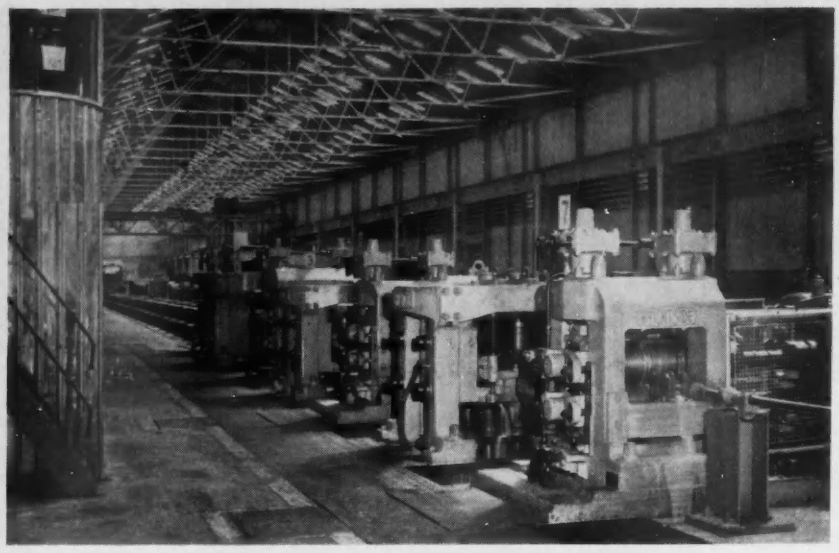
Another important feature in the maintenance of quality is the nature of the lubricant used at the dies during drawing. As was apparent at the recent Institute of Metals symposium on the subject of lubrication for metal working processes in the non-ferrous metals industry, there is still much to be learned about the selection of lubricants for the high-speed drawing of aluminium, and the Company is engaged upon a comprehensive investigation with the object of enabling the quality of product to be maintained as the speed of drawing increases.

Conductor Manufacture

Bare conductor for overhead transmission and distribution lines, with or without a steel core, is manufactured on a range of stranding machines in which the wires are built up in layers around a central wire, each layer containing a pre-determined number of wires. Conductors usually contain 3, 7, 19, 37 or 61 strands, but odd constructions are occasionally required. The largest standard size used in the 275 kV Supergrid, for which the Company has supplied a considerable proportion of the total amount erected, is a 61/·125 in. strand conductor. The Company has also made an experimental conductor of 169/·146 in. aluminium wire.



This machine straightens the wire and cuts it into convenient lengths for various uses



View of the seven finishing stands of the semi-continuous rod mill. The last stand of the mill (horizontal) is shown in the foreground with one of the vertical mills behind it. In the distance can be seen the long run-out table from the intermediate mill

The stranding machines in use are of the tubular and planetary types, the former being used for high speed stranding of steel cores, and the smaller size of aluminium conductor up to 7-strand. The planetary machines are used for larger aluminium conductors. Most of the machines were supplied by Trafalgar Engineering Co., Ltd.

Ancillary Processes

Many of the aluminium alloys handled require heat treatment, either at an intermediate stage in the wire-drawing process, when the wire is liable to become work-hardened, or at the finishing stage when it is desired to develop maximum strength, as, for instance, in the case of Duralumin type alloys.

For this work, four batch type, 140 kW electric furnaces of the forced air circulation type and with automatic pyrometric control were supplied and installed by G.W.B. Electric Furnaces Ltd. Control of temperature can be achieved within ± 2½° C. High speed quenching equipment is available, enabling a quench to be completed in 15 secs, minimum quenching time being a most important factor in developing the maximum properties of the heat treatable alloys. In view of the importance of the time factor involved in the quenching process the furnaces are located close to the wire-drawing machines.

The manufacture of narrow strip or tape—"flattened wire" as it is more often called in the wire industry—is carried out for the larger sizes on a Robertson-Tormanco flattening mill, with 9 in. dia. rolls and a speed of about 200 ft/min. A range of smaller mills is available for the lesser sizes. These mills can also produce sections of various sizes and have provision for layer winding into coils for many specialised applications such as the manufacture of zipp fasteners. The average speed of these small mills is 350-400 ft/min.

There is also a considerable demand for straight lengths of wire and rod, which are required by many industries for machining purposes and also for the manufacture of welding rods, knitting needles, etc. A battery of Thompson and Munroe straightening machines is installed covering the diameter range of 0·048 in. to ¼ in. Larger diameters up to ½ in. are straightened on a Barron and Crowther heavy duty machine. Straight lengths up to 16 ft can be produced.

In conjunction with the British Oxygen Co., the company has pioneered the manufacture of specially treated wire for the consumable electrode shielded welding process (variously known as Argonaut, Aircomatic, Sigma). This special process has now passed out of the development stage, and is rapidly assuming considerable importance. Extreme care is needed during the production of the wire and its chemical processing to ensure that no defect might occur which would adversely affect the strength of the weld or the continuity of the welding process. For this reason, the drying of the wire is carried out under conditions of scrupulous cleanliness and under controlled conditions of temperature and humidity and in the process of winding the wire on to the reels for shipment, care is taken that it is only handled by gloved workers as even the natural grease of the hand has a significant effect.

Laboratories

Laboratories are located adjacent to the main plant and are equipped with all the necessary mechanical, electrical, chemical and physical testing equipment required for the routine testing of the Company's products and their development to customer's specific requirements. An example of the type of research being carried out was demonstrated when we visited the works last week. This consisted of an experiment to see the behaviour of "Silmalec" wire used as a telephone line. The object was to determine the fatigue resistance of the wire under conditions similar to those occurring in practice. Arrangements are also being made in the laboratory to provide a test rig which will handle conductors in considerable lengths.

The output from the works may be broadly divided into four groups. First is wire for engineering, aircraft and general purposes; second there is wire for the electrical industry for use in insulated cables and windings; third, overhead conductors are made for transmission and distribution lines, and fourth hot rolled rod is produced. Wire is supplied in all grades of pure aluminium from superpurity (99·99%) to commercial (99%+) and in a range of alloys including all those in B.S.: 1473/5. For the electrical industry, stranded conductors are manufactured in all sizes in steel-cored aluminium (SCA), all-aluminium (A-A), Silmalec and steel-cored Silmalec (SCS). The company also supplies a complete range of fittings for overhead lines.

Our thanks are due to Aluminium Wire and Cable Ltd., for inviting us to inspect this efficient modern plant.

Circuit Design for Transistors

I.E.E. Radio and Measurements Sections meet to discuss characteristics of these semi-conductors

As design and measurement go hand in hand, in transistor circuitry no less than power engineering, the four papers presented last week to a joint meeting of the I.E.E. Radio and Measurements Sections on transistor circuit design and the measurement of transistor characteristics and parameters were closely related in many ways apart from the common transistor theme. Moreover, they provided a useful indication of the intensive research to which transistors are being subjected, to determine not only fundamental operating principles but the possibilities they hold out for application in electrical and electronic engineering. In the design of linear transistor circuits, the design engineer requires to know the characteristics of transistors operating under conditions of low signal levels—possibly as low as 10^{-8} amps—for a wide range of emitter currents. The latter can, in certain cases, be less than one microamp d.c. in value. It was the purpose of the paper by E. H. Cooke-Yarborough, M.A., A.M.I.E.E., C. D. Florida, A.M.I.E.E., and J. H. Stephen, PH.D., GRAD.I.E.E., to describe a suitable method for measuring such small-signal characteristics.

Although aimed primarily at determining the stability and triggering sensitivity of monostable transistor circuits designed to be stable in the "off" condition, the work provides results and methods of measurement which may help to throw light on the working of point-type transistors. In all, four characteristics were required to be measured, the small-signal resistances associated with the emitter, base and collector and the current amplification. The transistor may be regarded equivalent to a T-network incorporating these three resistors, one of which is shunted by a current generator, amplifying the emitter current by the amplification factor. Under these circumstances, the characteristics may be determined by adding small known alternating currents to the steady currents flowing in the electrodes and establishing its d.c. bias conditions. Alternating voltages resulting from the currents are then measured. But, over the wide range of direct current bias required, such measurements are beset with practical difficulties, especially as the alternating voltage may be so low as to be comparable with the noise level of the transistor. Moreover, conditions require some measurements to be made with the collector connection to be either open or short-circuited for a.c. whilst maintaining the d.c. biasing supply.

Bridge Circuit Technique

However, the method used by the authors circumvents these difficulties by connecting the transistor in a.c. bridge circuits so that the results are derived from settings of decade resistor boxes giving a null indication on a sensitive detector. To provide an effectively short-circuited collector, an a.c. voltage applied to it is in anti-phase with that generated within it, the amplitude being adjusted to give zero voltage across the collector electrode. To provide an open circuit, an in-phase applied voltage is adjusted to give zero voltage across a resistor in series with the supply to the collector.

A total of 38 transistors from four sources in three countries were subjected to measurement, results showing, initially, that reasonably close similarities in behaviour are displayed by transistors from different sources. Particular uniformity in values of emitter resistance was noted. The work showed that the small-signal collector and base resistances were largely independent of emitter current, the emitter resistance being nearly inversely proportional to it. With suitable circuit design, the paper concludes that transistors can be used in stable triggered circuits which have, under favourable conditions, a charge sensitivity approaching that of triggered thermionic valve circuits.

Another method for determining these a.c. parameters was described in the paper by A. R. Boothroyd, PH.D., GRAD.I.E.E., and S. K. Datta, M.SC. Using a bridge technique, this method again utilises the T-network equivalent circuit of a transistor, simulating this network in a practical arrangement of resistors which incorporate an amplifier to represent the current generator. It was used to measure the a.c. parameters by comparing the electrical behaviour of the transistor with that of the equivalent circuit, adjusting the elements of the latter until their behaviours are identical. The accuracy of measurement is quite high, particularly for the collector resistance which was determined to within ±2%. Measurement accuracies for the emitter and base resistances of ±3% may be obtained.

Transistor Circuits for Digtail Computers

Both remaining papers presented at the meeting were concerned primarily with circuit design for transistors. One of the important uses of transistor exists as an element in digital computers, and G. B. B. Chaplin, M.SC., GRAD.I.E.E., described various circuits for this purpose in which the transistor was considered as a regenerative amplifier. Bearing in mind that a typical output characteristic of an n-type point contact transistor having its base earthed is similar to that of a pentode valve, the problem was to design a circuit which has two states, "on" and "off," both well defined in potential and neither appreciably affected by changes in transistor characteristics likely in practice to vary up to several hundred %.

Although a squaring circuit provides a means of defining the two states, an input waveform is required to establish "off" and "on" conditions. As both input and output are in phase, however, positive feed back may be employed to create a regenerative circuit in which the states are self-maintained. Circuits employing this type of operation were used, making the regenerative transistor stable in the "off" state and switching them "on" by a comparatively weak trigger pulse. Powerful resetting pulses are then used to restore it to the "off" state. The principle can be applied to either negative or positive output circuits, whilst incorporating provision to reduce hole storage which otherwise would limit both ease and speed at which the bottomed transistor might be switched off. Such a regenerative transistor acquires characteristics to make it eminently suitable for operation in computing type circuits, especially where comparison of two or more pulse trains is required.

Whereas the previous papers were concerned largely with transistor operation at small signal currents, the final paper, by E. H. Cooke-Yarborough, M.A., A.M.I.E.E., described a versatile transistor circuit capable of handling up to several tens of milliamps. Several practical circuits were described, showing methods to make them sensibly independent of transistor characteristics.

Electricity for Productivity

E.D.A. CONFERENCE TURNS TO INDUSTRIAL REQUIREMENTS

BOTH of the papers presented when the E.D.A. Conference was continued on Thursday last dealt with the requirements of industry. In the morning, Mr J. R. Anderson, Sub-Area Commercial Officer, Midlands E.B., spoke on "Electricity for Productivity; Selling the Idea to the Industrialist," while in the afternoon, Mr W. P. Warren, South Wales E.B., discussed "The Scope for Electronics in Industry."

Mr Anderson stresses in his paper the importance of interesting just the right person in an organisation, in order to improve the use of electricity. He emphasises that the position held by the desired contact will vary widely according to the type of concern and its size. Seven possible methods of approach are suggested, and these are discussed at some length. The first of these methods is cold canvassing, i.e. calling unheralded on a consumer. It is considered that with suitable staff this may bring good results with consumers who have not responded to any other approach. Canvassing following a letter is a method that will work with some consumers, but it is found by experience that the letter too often fails to reach the man who would be interested. Direct mail will only meet with response if the letter can be addressed for the personal response of a named individual. "Selective appointments" is a term used when a person known to be interested in a proposition is visited by appointment.

Exhibitions offer special opportunities for meeting interested consumers, and there is interest here in the Industrial Showroom which has been set up in Birmingham. A suitable building has been adapted to serve for the display of equipment, and shows have been held at intervals of a wide range of industrial electrical equipment. It has been found impracticable to hold more than one exhibition of two weeks duration every month, both because of the physical change over of exhibits, and also because of the circularising and follow up work involved.

A Commercial Engineer was appointed at the outset to organise the exhibition and to be responsible for following up any specific problem raised by consumers within the district concerned who have visited the exhibition. He is also available to help other districts on request. All districts of the sub-area co-operate in staffing the exhibition.

Various methods of advertising the exhibition are used, including direct mail from districts to selected consumers. The manufacturers whose equipment is shown participate by circularising potential customers, and generally they share the cost of any press advertising. Attendance varies, but an average is about 100 consumers; or rather, their representatives. This is more satisfactory than it might appear at first sight since few trouble to come unless they are really interested. Each industrial visitor is personally conducted round the exhibition and the possible applications of the apparatus shown to his own problems is discussed with him.

Returning to the ways of reaching industrial consumers, advertising may be of general value, but only if there is some special feature or service to which it is desired to attract the industrialist's attention. Finally, in the seven methods, comes leads obtained from staff. Engineering staff are often in contact with industrial consumers, and they can usually arrange an introduction for a consumer's engineer. It helps, too, to keep the Board's engineering staff well informed of the commercial aims and of facilities offered to consumers.

Staff

Two categories of staff are required for promotional work with industrial consumers. The first is industrial general sales staff, and the second, industrial applications specialist staff. Those in the first class should be trained to handle general industrial enquiries, tariffs, and so on, and be capable of establishing confidence in the Board's ability to be of assistance. More attention needs to be paid to the training of such staff. Apart from satisfying the general requirements of the electrical salesman, they should have a sound basic engineering knowledge—O.N.C. may be adequate if the principles are well understood—and they must have a fair idea of the possibilities and limitations of the industrial applications of electricity.

Specialist staff should be capable of advising consumers fully on a specific application, and of preparing schemes which in some cases may be extensive and elaborate. Typical specialist subjects might be: mechanical handling, welding, h.f. heating, electronics, machine tools, ceramics and lighting. The men must be specialists in their own right; because an appointment is made at district level, say, it does not mean that there should be a "super specialist" at each of the higher levels. This essential requirement of course pre-supposes the payment of an appropriate salary, and it is suggested that the salary must be the prime consideration rather than N.J.B. classifications and grades. It should be noted that the gas industry has used specialist staff on a somewhat similar basis for some time. Experience indicates that industrial consumers welcome the services of an independent authority willing to advise them.

Electronics

The gradual introduction of electronic techniques into industry is discussed by Mr Warren with particular attention to the reasons why industrial managements have been reluctant to introduce them. It is felt particularly that in view of the low availability of fully trained industrial engineers, the supply industry should endeavour to provide an advisory service which is at present lacking. The approach in such cases must be not to the works electrical engineer, but to the management or production staff.

In his paper Mr Warren gives an interesting review of available electronic devices and of some of their applications, but attention here may be more usefully focused on his remarks about experience with the operation of the plant. In this respect the table shown is particularly enlightening. The answers given are those obtained when the questions shown in the left hand column were put to a wide range of factories, all of whom made some use of electronic equipment. Mr Warren goes on in his paper to comment on some of these answers.

So far as initial installation is concerned, some irritation may be caused by the stabilising period which is required

before circuits settle down. This may extend up to three months in some applications.

Since electronic equipment is commonly associated with mass-production methods, maintenance must be possible with ease and speed. Mr Warren is in favour of sub-dividing all electronic circuits into "jack-in" units, so that in the event of one unit failing, such as an amplifier, it may be replaced quickly by a sound substitute. Where d.c. amplifiers are involved, however, even this jack-in technique may not be satisfactory, because of the time taken to stabilise. In such cases if the production cost of a breakdown is very expensive, the apparatus must be duplicated.

The author's preference as revealed in his remarks, is for maintenance staff with some radio knowledge. Employment of men with up to five years' experience of radio and light current work is mentioned in one case, with a six months' training period to accustom them to auxiliary industrial power equipment.

There is an interesting divergence of opinion in the table on the robustness of electronic equipment as offered for industrial use. The general opinion is that the electronics departments of large electrical engineering manufacturers have not yet benefited from the long experience of their colleagues in the power side of their firms. So far as reliability is concerned, the dry joint is an almost universal cause of trouble, and the suggestion is that some form of connection other than soldering should be considered.

Valve life always attracts attention, and it is worth notice that none of the users quoted expresses dissatisfaction on this ground. In spite of the guarantee of only 1,500 hours life, tubes usually last in the region of 10,000 hours. It would help if the British Valve Association would guarantee a more realistic life, as increased sales of equipment would result from increased confidence.

General Discussion

On Friday morning, the closing session of the conference was devoted to a general discussion which covered a wide range of topics. Mr V. Dale, Director of E.D.A., was in the chair, and in his opening remarks he reviewed points made in the discussions on the conference papers. Amongst those which he thought worthy of further discussion were the idea that E.D.A. should run a training establishment for salesmen, and that there should be an E.D.A. technical advisory service at national level. He recalled that where industrial and rural electrification were concerned, it was agreed on all sides that it was necessary to get more salesmen and to train them to earn their keep.

Another subject of some importance concerned the E.D.A. advertising campaign. All trends suggested that the current equipment campaign would continue into 1955, but there had been suggestions that attention should be given to reorganising a rewiring campaign, with a view to encouraging adequate wiring.

Referring to a suggestion that people would no longer watch "ordinary" demonstrations, which was made in one of the conference papers, Mr Dale suggested that the present "star" presentations to large audiences were a passing phase. Individual, top-class demonstrations to small audiences could do more good in the long run.

When the general discussion began, it centred for some time on the question of who to approach in an industrial undertaking and on the amount of engineering knowledge necessary. One school of thought recommended approaching the accountant, and deprecated presenting electricity as a good or interesting engineering achievement; another felt that salesmen must be trained engineers, so that they were in a position to analyse and evaluate alternative methods. On the more general selling question, there was a claim for a special grade for showroom personnel, with a separate scale of remuneration.

One speaker brought the discussion round to the question of load factor with a reminder that the area boards comprised a service industry, and not one established to make profits. It was part of the electricity salesman's job to make clear to industrial consumers the effect of the various tariffs that were available. A Chief Commercial Officer took up this point, with a reminder that although it was the demands that filled the load curve valleys that kept the cost down, it was sometimes necessary to develop demands which were unsuitable from this viewpoint.

Later the subject of the discussion changed to a possible central E.D.A. school for the training of salesmen. It was pointed out that one of the main problems of this idea was that it took salesmen away from their showrooms. It was emphasised that arrangements already existed whereby E.D.A. would give any area board a "tailor-made" scheme for the training of supervisory staff. One speaker took the point that training was no substitute for experience, and that if training was overdone, then experience was lost.

After this final session, the Conference Luncheon was held, with the Chairman of E.D.A., Dame Caroline Haslett, in the chair.

Experience of Users of Industrial Electronic Equipment

Type of Consumer	Tinplate	Rod Mills	Light Engineering	Plywood Veneers	Domestic Equipment
Maximum demand, kW	20,000	7,000	5,000	700	800
Electronic tubes on circuit	2,000	50	10	20	500
Question					
1. In general, have you a favourable opinion of electronic equipment	Yes	Yes	Fair	Yes	Yes
2. Did you experience any difficulty in its installation	Very little	No	No	No	Very little
3. Has maintenance been difficult	Not unduly	No extensive maintenance	None	No	No
4. Does preventive maintenance seem essential	Yes	No	No	No	No
5. Did the use of electronic equipment necessitate additional staff	Yes	No	No	No	Yes
6. If you have to train staff, do you prefer (*a*) a radio technician to train as industrial, or (*b*) an industrial technician to train as radio	Radio	Industrial	Industrial	Industrial	Radio
7. Does the general design of electronic equipment seem sufficiently robust for industrial use	No	No	Yes	Yes	Yes
8. Has the equipment proved reliable	Yes	Yes	Fair	Yes	Yes
9. Do you consider the manufacturer's guarantee life conservative	Yes	Yes	Yes	Yes	Yes

From an engineer's notebook

THE photo-electric burglar alarm does not seem to have been adopted to the extent that its merits at one time appeared to justify. Only amongst schoolboy visitors to the Science Museum has it achieved limitless popularity. One wonders, therefore, whether the more recent suggestion of a burglar alarm employing ultra-sonic waves will be more successful. Such a method has one outstanding advantage over the photo-electric method, since it is not essential for the beam to be interrupted by a solid body to set off the alarm, any air movement in the vicinity that will sufficiently displace the beam will operate the circuit. This system, therefore, should provide a greater area of protection than the photo-electric method and further has the attendant advantage that it will also operate in the event of a fire by reason of the displacement of hot air. One wonders whether an occasional draught may not have the same effect. Perhaps the greatest claim of all is that the system not only offers the protection mentioned above but effectively kills mice and drives away rats as well. For the production of these ultra-sonic waves, magneto-striction is used, generated in four nickel rods riveted to the bottom of a can which forms the transmitter; the operating frequency is in the region of 19,000 c/s. This device must be one of the few commercial uses of magneto-striction, that effect which bedevils any attempt to reduce the noise from power transformers. The moral of this story seems to be, that if the electrical pioneers had chosen a higher distribution frequency they would have had no trouble with mice causing short circuits in substation switchgear.

* * *

IT is a far cry from the variation in length of a rod by magnetostriction to the operation of a muscle, but I was interested in some recent experiments to simulate the action of muscles by the use of gels. Certain gels consist of a network of thread like molecules linked in long chains permeated by a liquid. These threads are flexible, tending to coil up under the influence of neighbouring molecules but under certain electro-chemical conditions the molecular chains will uncoil leading to an expansion of the gel. The material used for the experiments was polyvinyl alcohol which has the surprising property, that although normally soluble in water, if placed under tension is no longer soluble since the molecules are extended by tensile stress. The liquid permeating the gel together with the surrounding water can be regarded as an electrolyte. When this is electrically neutral the molecule threads will be in the coiled position. If, however, acid is added, the ion content will in turn ionise the molecules of the gel which will repel each other, stretching and straightening out the chains thus causing the polyvinyl alcohol to expand. Conversely the gel can be made to contract to any intermediate value by reducing the ion concentration of the electrolyte. In the experiment, by varying the acidity of the solution, the gel was actually made to perform work. This investigation throws an interesting light on some of the research work that is being undertaken in our laboratories in order to elucidate theories of simple physiological phenomena.

IN that classic story of the man who married a dumb wife, once the wife's tongue strings had been slit, the husband was forced to seek the solace of deafness in order to escape from incessant nagging. Now, it would seem, science may be able to provide a less drastic remedy. Certainly not before its time, since modern civilisation has brought with it an increasing level of noise and if the ducking stool were still extant most of our inventions would be due for a ducking. This latest idea for reducing noise is one of those neat twists which have their own special fascination; it is simply to counter one noise with another. This noise neutraliser consists of little more than a microphone and loudspeaker with the usual electronic gadgets that go in between. The sound to be obliterated is picked up and its phase changed, then after suitable amplification it is re-emitted through the loudspeaker, the two noises, it is claimed, neutralising one another. I rather suspect the device is severely limited in the number of frequencies it can handle at one time and the polyfrequency noise of the city during the rush hour would break its heart. The matching of volume over a reasonable area must also be something of a problem and unless the automatic volume control is considerably better than the one on my wireless set there is a fifty-fifty chance that the loudspeaker will add rather than detract from the noise level. None the less for limited spaces and with single frequencies the method has obvious possibilities.

* * *

THOSE of us who indulge in the expensive hobby of snapshotting know that even with these ultra fast films we are persuaded to buy, our noble "Brownie" is not equal to the task of producing satisfactory pictures in anything other than good light. For such reasons I read most avidly of a new type of camera which is claimed to produce satisfactory images in the dimmest of lights. It was developed primarily for use with X-rays, but is said to have application within the visible spectrum. With this method, there is placed in front of the normal photographic plate a second plate separated from it by a short distance and one that is transparent to the radiation to be photographed. Between these two plates a high potential is established so as to utilise the principle of electron multiplication similar to that in a Geiger counter. As a single element of X-ray passes through the transparent plate it releases a stream of electrons towards the photographic plate, it is this beam which affects the silver in the emulsion to a far greater extent than would the original radiation. The emitted beam is said to have little spread and with the plates reasonably close together a higher standard of photographic resolution is obtained than I would have thought possible. The idea has the merit of simplicity for difficult cases of photography and an application that jumps to mind is the X-ray examination of dense metals. But until someone provides a compact portable h.t. source and a simple method of changing film without breaking the partial vacuum we snapshotters shall still have to be content with the limitation of our box cameras.— *E. R. G.*

INDUSTRIAL MAINTENANCE

A special monthly section of the Electrical Times

Removing Ball Races

Workshop Methods for Difficult Cases

by Karl Wilkinson

DISMANTLING machinery for overhaul is, generally speaking, a normal straightforward operation but the withdrawal of bearings, pulleys, pinions dog drives, and similar parts presents an everlasting problem to the maintenance man; a problem concerned not only with the removal of a part but also with the damage to any associated equipment. Naturally the means used, and the difficulties encountered depend on whether the repair is to be made in a well-equipped workshop or on site. Admittedly, a range of pulley drawers is absolutely necessary in any condition but in addition to this, special devices must frequently be made up and other expedients adopted.

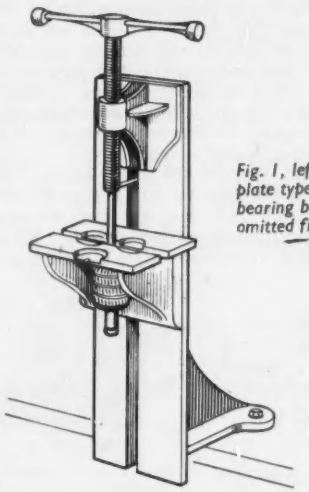


Fig. 1, left, shows a fish-plate type of puller. The bearing being removed is omitted from the drawing

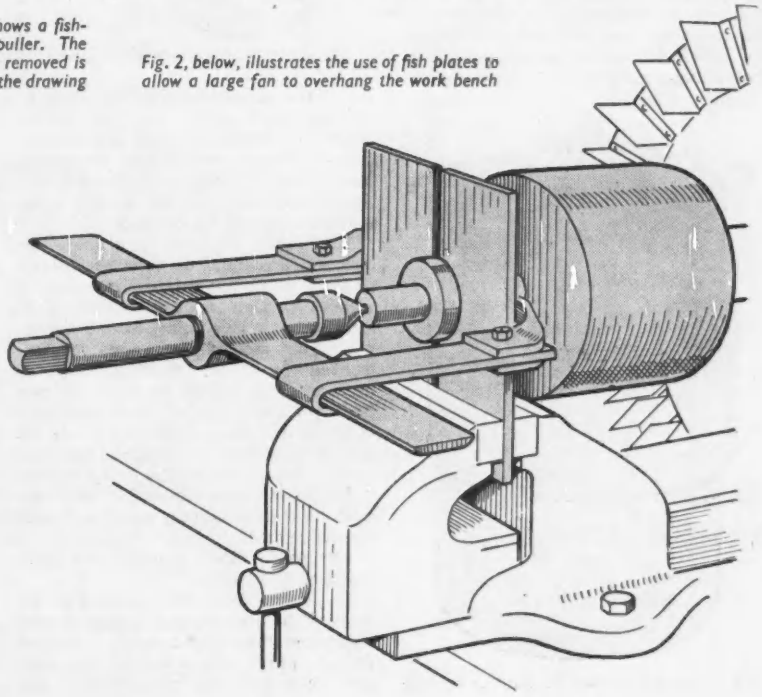
The ordinary pullers need no special mention but there is one type which is particularly useful and yet seldom found outside an automobile electrical workshop (Fig. 1). This press uses fish plates to pass behind the part to be removed. In some models these fish plates can be bolted together and their bevelled edges permit their insertion in a very small cavity (3/32 in. to ¼ in.).

These same fish plates can be used in other ways. For example (Fig. 2) shows them held in the vice, so allowing a large fan to overhang the bench. Such large parts may prevent the use of the press previously illustrated. A large two leg puller is used to apply pressure and the fish plate can, if necessary, be afforded additional support by G cramps and side plates.

When things are getting desperate and extreme measures are called for, these same plates can be used as shown in Fig. 3. The part is supported, in our example, by the fish plates resting on a stack of old d.c. motor yokes (which are, incidentally, most useful things to have about the workshop). The rig-up should rest on a solid floor or on an anvil if one is available. Force is applied by a sledge or floor hammer while the end of the shaft is suitably protected.

While it is freely admitted that this is a violent method it is, as a last resource, extremely successful and a shrewd blow will often move a part with far less damage than might be caused by a screw press; the sudden shock of a heavy blow will often dislodge a seized part which would not budge under a gradually applied pressure.

Fig. 2, below, illustrates the use of fish plates to allow a large fan to overhang the work bench



This question of slow pressure brings us to the later type of pullers on the market with the central screw mandrel fitted with a hydraulic ram.

It must be agreed that these are a distinct advance and when used on solid parts are most effective. When, however, they are used to pull parts that have a considerable amount of inherent spring, the movement of the hydraulic ram is so slow that it may fail to shift a stubborn article until almost the end of the ram travel is reached, or may only bend the flexible portion, without cracking the joint. In such cases the sudden snap given when an ordinary screw press is spun round, may be a distinct advantage.

For small work, i.e., parts such as shafts or armatures with bearings and without large fans, etc., an ordinary fly-press is excellent. Here again we have a particularly sudden blow as the heavy ball is swung round. As before, fish plates, or in some cases, special jigs support the work on the foot of the press. The size of the work that can be accommodated depends, naturally, on the diameter of the hole in the press base.

The fish plates mentioned above can be bought separately. They are rather expensive but can if necessary be made from ½ in. to ¾ in. spring steel, i.e., leaf spring steel, subsequently hardened and the temperature drawn down.

There is one other type of bench puller that must be mentioned (Fig. 4) and this is probably the best available for small work where the shaft overhang is not very long.

In all cases of difficulty in drawing parts, these points must be considered:

1. The portion of the shaft, for example, over which a part has to be drawn, must be clean and not bruised or upset by previous attempts.

2. If the construction permits, it may be better to drive the part still further on before attempting to remove it, so permitting a rusty shaft to be cleaned before the part is drawn. This is a common practice in the removal of pulleys fitted with parallel keys, since it may leave the key behind and possibly leave it loose enough to be pulled out as a separate item. When such a procedure is adopted on a motor, the opposite end of the shaft should rest on a dolly to avoid, as far as possible, any damage to the bearings while the pulley is being driven on.

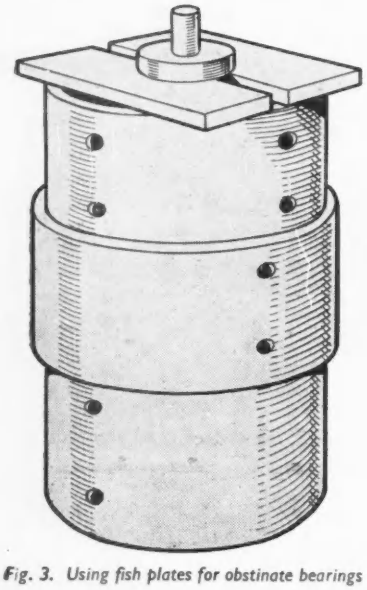


Fig. 3. Using fish plates for obstinate bearings

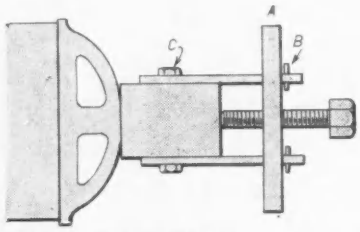


Fig. 5. Removing a pulley which has been driven on too far. At B are shown silver steel retaining pins.

3. Heat and penetrating oil are great assets.

4. Thin collars or spacers, crushed on a shaft, can sometimes be loosened by peening the surface with a hammer and so expanding it.

5. In bad cases it is often cheaper to remove a ball race by cracking and destroying it rather than damage or bend the shaft by prolonged struggling.

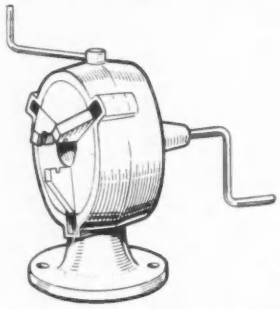


Fig. 4. Type of puller for small work

6. Heat can be combined with cold to release a tight part. Any refrigerator agent will supply a small cylinder of methyl chloride or similar refrigerant furnished with a length of ¼ in. tube. The liquid is squirted over, say, a shaft while a flame is played on a pulley.

7. In spite of every care there are numerous examples of parts pressed on to shafts which are impossible to remove without causing damage to associated mechanisms. This points to bad design.

8. The method, so often recommended by motor manufacturers, of drawing off a bearing by using its own back plate as a puller, is a very risky business and since these back plates are usually cast-iron, or die-cast, they frequently fracture before the race is moved.

9. Having once removed a very tight part the shaft or housing must be cleaned up and refitted.

10. Avoid direct blows on the screw mandrel of a puller.

11. Apart from the problems of extraction that can be tackled with normal equipment there still remains a number of parts which demand special tools without which little can be done. Into this category fall ball bearings in blind holes, bushes in blind holes, very small magneto type races and large diameter parts where the central boss is below the level of the periphery, so preventing a direct pull on the boss. There is no easy way out of these troubles and the necessary equipment must be made up, as it is seldom obtainable on the ordinary market.

Aluminium Housings

Ball bearings and aluminium housings present their own especial problems. While it is considered to be good practice to insert steel, brass or synthetic liners in the better quality machines, nevertheless many pieces do not have these refinements and the success of the assembly rests on the accuracy of the fitting. There is unfortunately a tendency to have the interference fit too close, partly to counteract the difference of coefficients of expansion, and while the pieces are quite easily assembled in, say, a mandrel press with a registering jig, their dissembly may not be so easy.

Many aluminium castings, such as end plates, when in position and bolted and spigoted to an adjacent part are quite rigid and adequate for their purpose, but they may be rather frail as a separate item. This may mean distortion when attempting to remove a bearing from a housing, using a normal 2- or 3-legged puller. Much better results are obtained, when possible, by using a screw press where the end plate rests upon a flat bed and pressure is applied accurately at right angles. Where the casting is fretted, or of cruciform pattern it is wise to scotch up any recessed part with a suitable dolly to avoid any spring in the metal and to get direct pressure on the part to be removed.

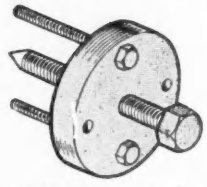


Fig. 6. Universal tool for use where tapped holes are provided

Heat on these aluminium parts is frequently indispensable but in spite of this aid many bearings will be found too tightly fitted and the housing may be tightly scored and the aluminium "picked up." Such scoring should be eased with a scraper before assembling.

Aluminium under certain conditions and in the presence of water, may corrode badly as, for example, a head or cap held by a number of studs. The studs may be rusty and swollen and the stud clearance still further reduced by an

accumulation of white powder resulting from the disintegration of the aluminium.

If a little acetic acid is poured round the studs and left for some hours the removal is made easier.

Keys and Shafts

The removal of a correctly fitted key should give no trouble whatever, but bad workmanship, rust and mechanical damage may easily make the job almost impossible. Admittedly there are well known dodges to try, such as drilling, tapping and pulling out the key or driving the part, e.g., the pulley, further on (see above), but a key too tightly fitted and driven in hard and flush resists most attacks and usually has to be drilled out.

The standard parallel key (without gib head) is to a very great extent, replaced by a Woodruff key in most small mechanisms. They have many advantages, and are almost indispensable in some assemblies. On occasion they can be hidden and overlooked and one or more parts, being drawn off a shaft, may mask a key concealed in one of them, as, for example, a sprocket, spacer collar and ball bearing on some dynamo shafts, where sometimes the arrangement is to have a splined sprocket and in another a Woodruff key. In the latter case an attempt to draw the whole assembly may fail because the hidden Woodruff key will foul the ball race. Unknown parts, covered with dirt or grease should always be cleaned and inspected first.

Woodruff keys are removed by a smart blow with a hammer and drift on one end of the key while the shaft is resting on a lead or brass block.

Still smaller mechanisms use a housed key in a key-way with stop ends. If these keys have been damaged it might be difficult to decide whether it was a Woodruff or a parallel key, and as the projecting edge is hardly high enough to grip, it might be necessary to machine off and recut at 90°.

Removal of Pulleys

If the pulley was correctly fitted in the first instance, no trouble should be experienced in removing it but the fitter will frequently meet such items that have not been dealt with properly or have become corroded.

First we must refer to the perpetual trouble originated by previous attempts at removal which result in riveting the end of the shaft and making the removal of a pulley impossible until the flare is machined off. The shaft must be trimmed, and although the easiest way is obviously by drilling, one could hardly do so on a shaft of the size in question.

A ring of holes could certainly be drilled towards the edge of the shaft but this would still leave the lands between the holes to be removed. Another way is to drill a ring of suitably spaced small holes and follow up with a spot facer fitted with a guide pin to fit the holes drilled.

Secondly we have the bad example of a pulley driven on too far, which only just clears the end plate of the motor. This is only possible when the boss of the pulley is recessed at each end and allows the skirt to overhang the motor bearing housing. An ordinary puller cannot be used since there is no clearance for the leg to hook on. The illustration shows one (Fig. 5) method of tackling this problem. It requires a special tool.

A heavy bar, about 3 in. by 1 in., fitted with a screw mandrel, is provided with a pair or a series of holes, through which pass the puller legs of parallel flats which are retained by the pins B of $\frac{3}{8}$ in. to $\frac{1}{2}$ in. high-tensile or silver steel. The ends of the legs are drilled and bolted to the pulley by $\frac{3}{8}$ in. to $\frac{1}{2}$ in. high-tensile bolts. If the legs tend to swing skew under pressure, two holes could be drilled or a pair of G cramps used.

Thoughtful manufacturers often provide tapped holes in a part to permit their removal. Such is the case with pump impellers and pinions which have two tapped holes in the shaft boss. This only requires a simple universal tool as in Fig. 6 which, by merely drilling two or more extra holes, will adapt to most jobs.

Unknown Fixings

The first step in removing any part is, beyond doubt, to determine what method was used to fix it. This is no easy task if the mechanism is unknown and the fitter must rely on his experience of similar mechanisms and a knowledge of the possible variations used. It is often a help if the maker of the mechanism is known since many manufacturers tend to follow a similar style throughout a wide range of goods, hence by inference, the fixing of a part can be surmised.

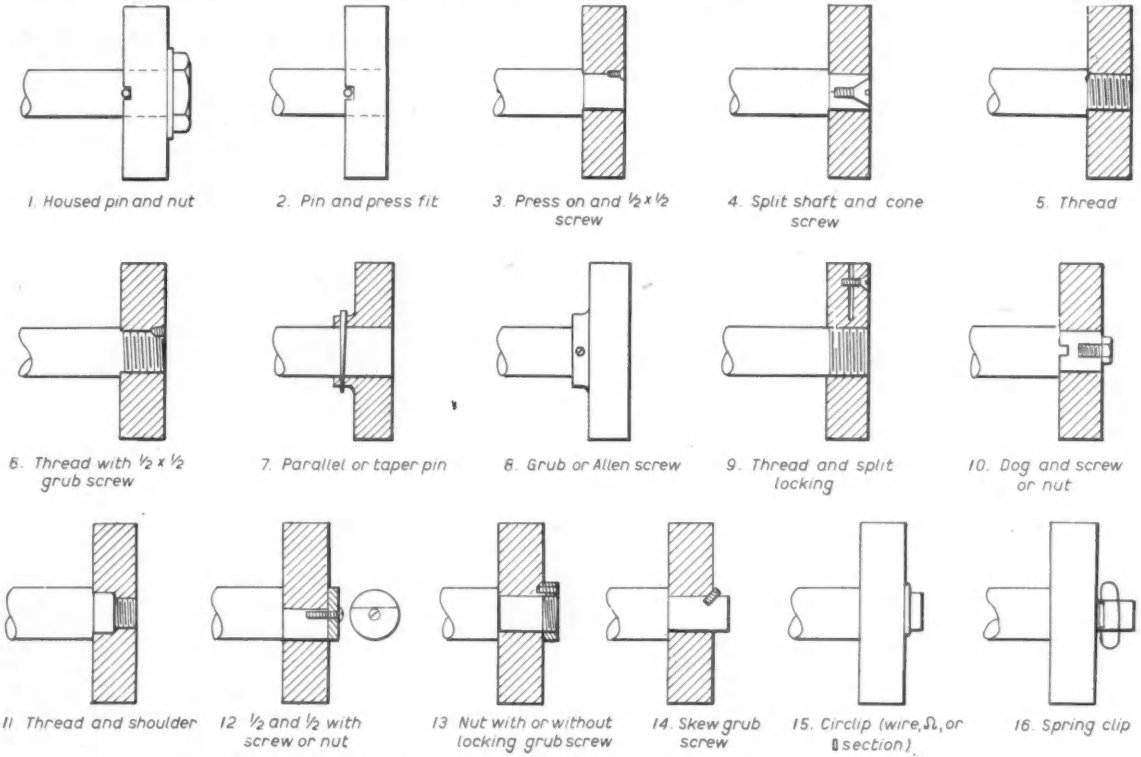
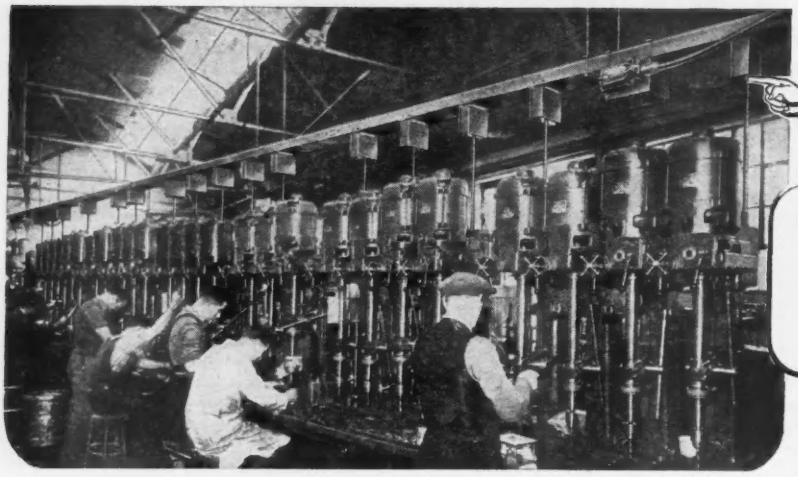

1. Housed pin and nut
2. Pin and press fit
3. Press on and ½ x ½ screw
4. Split shaft and cone screw
5. Thread
6. Thread with ½ x ½ grub screw
7. Parallel or taper pin
8. Grub or Allen screw
9. Thread and split locking
10. Dog and screw or nut
11. Thread and shoulder
12. ½ and ½ with screw or nut
13. Nut with or without locking grub screw
14. Skew grub screw
15. Circlip (wire, Ω, or ▯ section)
16. Spring clip

Fig. 7. Some methods of fixing parts to shafts which may be met when dismantling electrical equipment

RIGHT ON TOP OF ITS JOB!



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B.T.H. DOC 71 Direct-on-Line Contactor

DATA SHEET 4

THE contactor as illustrated is a surface mounting starter housed in a die cast box of modern design combining elegance with sturdy construction suitable for arduous conditions. The cover, with integral Start and Stop buttons, is flanged and spigotted as a protection against dust and damp. The complete starter weighs approximately 5½ lb with overall dimensions: width 5⅛in., length 7 in. and height 5 in.

The case is provided with three ¼ in. tapped holes, two at the top and one on the left. Semi-flush mounting is also available and is most suitable for machine tools; the recessed box giving complete protection to all live parts and permitting wiring to be carried out from the front.

The DOC 90 is a similar contactor but can be provided with clamp for v.i.r.w.a., v.i.r.l.c.w.a. or sealing boxes for p.i.l.c.w.a. with an ammeter if required. A semi-recessed form is also available in this model.

These contactors are designed for single or polyphase non-reversing squirrel cage motors with frequent starting. The ratings permit the usual 25% sustained overloads. (See table overleaf.)

Construction

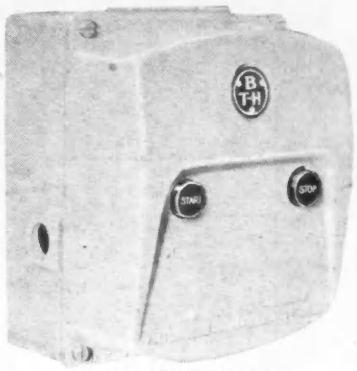
The starter, comprising three main mouldings and magnet assembly, is mounted on a base plate and fixed in the case by two screws at the bottom and two (captive) at the top. The contactor is actuated by a solenoid coil, gravity controlled with satisfactory working up to 30°-40° out of vertical. The armature carries four double-break contacts, three for the line currents and one for the contactor coil and pilot circuit.

The thermostatic overload relays are of the hand reset (by the Stop button) latched pattern with heaters in three phases possessing a lag time-constant enabling them to pass starting and other high transient currents while they will trip under continuous overloads or unbalanced loads due to single phasing. Since the relay depends on the heating effect of the current it automatically takes into account the ambient air temperature and the motor winding temperature at which the relay operates is always substantially the same.

The relays are calibrated in amps with three settings. Separate fuse protection is recommended.

Maintenance

Keep clean. Do not reface the silver on copper contacts but replace when worn and contact pressure is lost. New springs should be fitted at the same time.



Exterior of DOC 71 Starter

Fitting New Parts

1. Remove contactor from case—two screws at bottom and two (captive) at top of steel back plate.
2. Remove steel back plate—three hexagon screws and one countersunk.

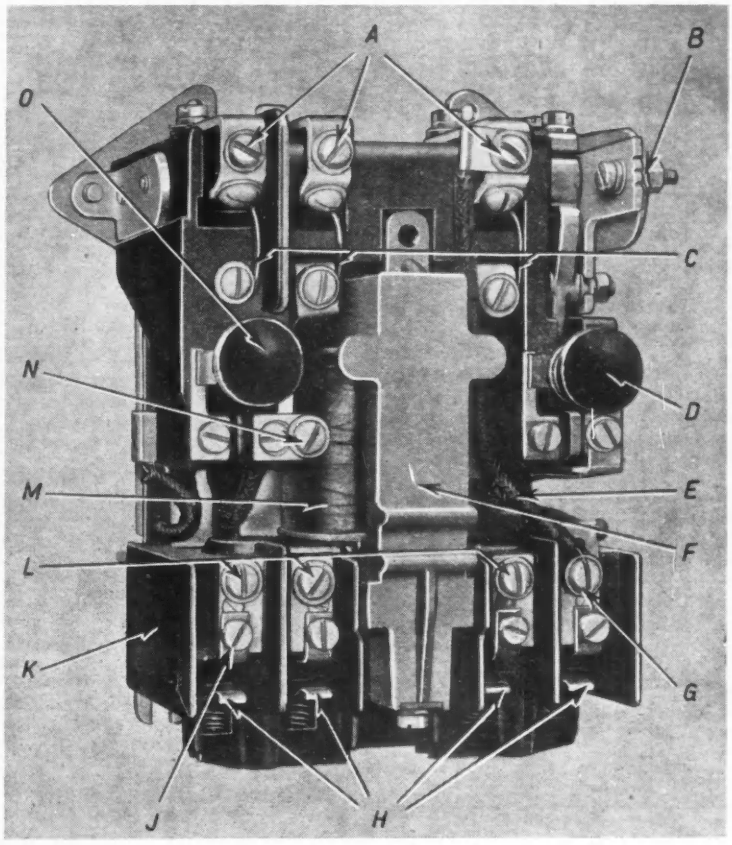
All fixed contacts can now be replaced, each being held by one screw.

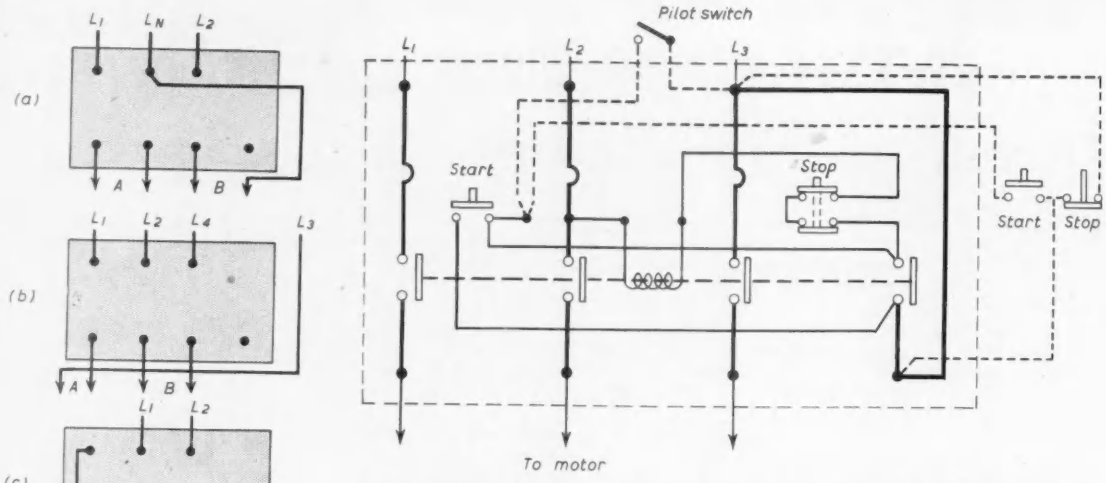
Spare Parts and Details

The illustration on the right shows the DOC 71 starter with cover removed. The key to the parts indicated is given below. Numbers, where mentioned, refer to catalogue references for spare parts.

A Supply terminals.
B Overload relay adjustment.
C Overload relay heaters.
Quote form letter and numeral on starter cover when ordering new heaters, etc.
D Stop and overload reset button.
E Jumper.
F Magnet.
G Auxiliary retaining switch.
H Main contacts, moving—C77216.
J Main contacts, fixed—C77217.
Springs for main contacts—C82570. Packaged sets are available containing the two contacts and the spring.
K Moulding; C82563, carrier for moving contact; C82569, support for fixed contact.
L Motor terminals.
M Operating coil—state voltage and frequency when ordering spare.
N Control terminal.
O Start button.

Other spares which may be needed are:
C79510, fixed contact and C79507, moving contact for push button & o/l.
C79509, push button spring.
C79508, tripping spring.

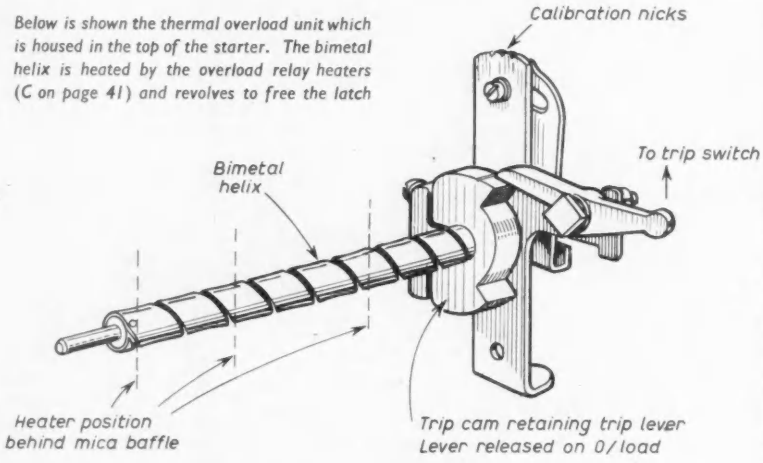




Above is shown the internal wiring diagram of the contactor, with dotted lines showing remote control connections. For remote control the link from L3 to the bottom right-hand contact shown by a thick line (jumper E overleaf) is removed

On the left are seen the external connections for use other than on a three-phase supply. (a) refers to two-phase, three wire ; (b) to two-phase four wire ; and (c) to single phase motor

Below is shown the thermal overload unit which is housed in the top of the starter. The bimetal helix is heated by the overload relay heaters (C on page 41) and revolves to free the latch



Removing Armature and Moving Contacts

Unscrew armature stop (cranked brass strip). This allows armature and contact moulding to be lowered. Contacts are removed by turning them on edge and withdrawing.

Starter Ratings

The table below gives the maximum continuous h.p. and peak currents which may be controlled.

V	H.P.		Max. Peak A.	
	DOC 71	DOC 90	DOC 71	DOC 90
*2 or 3 Ph.				
200/250	3	3	80	85
346/380	4	5	60	85
400/500	5	7½	60	85
500/550	5	7½	50	65
1 Ph.				
200/250	1	1½	80	85
346/380	2	3	60	85
400/500	3	3	60	85
500/550	3	3	50	65

*Two-phase requires isolator

To Remove Coil

After 1 and 2—

(a) Undo two screws now visible on underside of mouldings (N) (see photograph on page 41).

(b) Remove jumper (E).

(c) Undo screws holding coil leads.

(d) Slacken off three screws on back of contactor holding forked ends of three contact strips.

(e) Lower mouldings (K).

(f) Lift out magnet, remove split pin and internal slides and withdraw coil.

If the h.p. rating has to be altered, new thermal heaters must be fitted complete with calibration plate. A range of 22 relays is available, for ·5-13·5A.

In *no circumstances should the setting of the latch cam be altered.* Do not increase beyond the stated range of the starter.

Plant Engineers and Management

WORTH-WHILE advice on how the plant engineer can help and please his management was given by Sir Oliver Lyle recently in an address to an Incorporated Plant Engineers' refresher course. He summarised the main points of his address as follows:

Make a list of all breakdowns and find out how much they cost the company. Without knowing this at least for big breakdowns that stop the whole place, you cannot take a decision on whether to advise stand-by plant.

Find out whether your manager likes "paper" or talk. Then write very simply and very shortly, but make it simple rather than short. Note your estimates of time, cost and savings, and compare them later with what is achieved. Then evolve a "private personal correction" so as to become "that peerless, that precious, that priceless paragon, the engineer whose estimates can be relied upon." But personal ideas are not enough. Before putting forward a scheme, find out if your production colleagues are hatching a better one.

Don't fall into the trap, when doing experiments, of making a spurious correlation that isn't really there. Try out every experiment, however successful, several times before making up your mind, and always scratch your head before adopting an idea, in case there is a better answer. On this question of experiments, Sir Oliver stressed that it was difficult to keep errors to within ±10% in a works experiment and so if a new technique showed a genuine improvement of 10%, it might appear on a single trial as no change at all, or as a brilliant +20% success.

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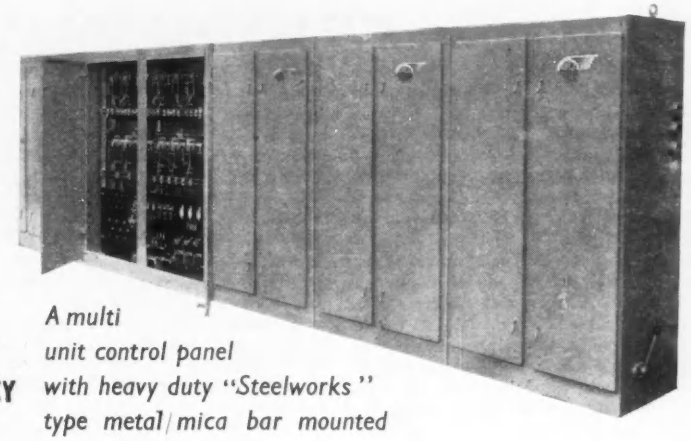

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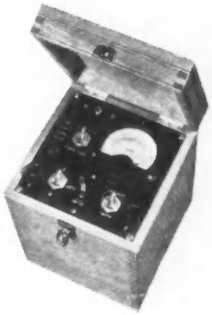

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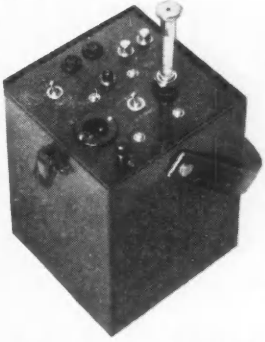

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Some Points about the Electricity Regulations

Part 4

by H. W. SWANN, O.B.E., D.F.H., M.I.E.E.

AT the end of the previous article in this series, which discusses the Factories Act 1937 and the Electricity (Factories Act) Special Regulations 1908 and 1944 I was discussing the adequacy of circuit protective devices, particularly fuses. Regulation 1 affects these with its requirement that "all apparatus and conductors shall be . . . so constructed, installed, protected, worked and maintained as to prevent danger, so far as is reasonably practicable."

I once ran a sales and wiring department for some years and do not remember being worried about fuse rupturing capacity, although we did know that a heavy fuse wire was more likely to wreck the holder than a light one, and by trial and error we overcame our troubles as they came along. Several of my distribution fuse boards flashed over from end to end and after having had to put in free replacements I reached the conclusion that something must be wrong. The troubles seemed to start with ordinary kinds of small short circuits in flexes, or bad lamps, which should have cleared cleanly. We always fitted double pole fuse boards and I think some of the wiremen may have put stiffer fuses on the neutral side than on the other because in some cases at least, we found all neutral fuses intact after the live group had flashed along the line. This would mean that the full circuit voltage appeared across the fuse as it went and left the outgoing contact or terminal at the opposite potential from its adjacent neighbours in the line. There was little or no shrouding between adjacent contacts, and we conjectured that the puff from the melting fuse initiated flash over to the next contact making its fuse blow and so on down the line to the end.

It seemed to me at the time that there was as much need for barriers between adjacent fuses, as between live and neutral groups of fuses in d.p. fuse boards. Since then I have seen fairly large single pole fuse distribution boards which were badly burned out in the same way but shrouding of contacts is now much more complete, and I do not think there are many present day troubles of the character I have described. Shrouding of contacts has always been asked for by the Inspectors but usually I think for purposes of a later regulation (No. 3) to prevent the hand touching live metal. If they have stopped flash overs as well, they builded better than they knew but I expect the manufacturers could put me right about this.

I think it was the late Mr Pooley and Mr Vernon Hope who introduced me to the mysteries of prospective fault current, potential fault energy and high rupture capacity fuses. This development came along at a time when fuse failures were becoming more frequent, and had caused accidents, and there can be no doubt that it has prevented many more at switchboards and heavy fuse distribution units. The majority of the fuses in use today are, however, still of the improved rewirable type, and experience has not shown that as a type they are inadequate for purposes of the Regulation. Much more information, based on performance tests, is now available about fuse characteristics and although no two makes seem to be quite alike, this is true also of a great many other things where a manufacturer wishes to preserve distinctive characteristics of his product.

If the plant engineer knows the conditions of service, he should not be in any great difficulty in choosing the right fuse, either h.r.c. or rewirable, but he does not always know them and it is not always easy for area boards to furnish information about fault energy in each and every case. Supply distribution conditions may change, and although area boards now commonly respond to enquiries from their larger consumers on high voltage supply, there is uncertainty about ordinary mains distribution supply conditions which, however, could probably be resolved by a consumer's engineer who was really anxious to find out about it.

Dominions Rule

Speaking from memory I think there is a rule in one of the Dominions to the effect that any consumer's installation within 100 yds of a 500 kW supply transformer shall be protected by h.r.c. fuses. I may not have got this right but it serves to bring out my point about the difficulty of calculating the fault energy in each and every case, and this rough rule could at least save the authority concerned a lot of trouble and argument if they have the power of arbitrary enforcement. There is nothing like this here—which is perhaps just as well—and so in a good many cases plant engineers may have to be guided by their experience. Although some approximate assessment of the supply conditions is certainly desirable there are many situations in fringe and rural areas where the fault energy is unlikely to be heavy, and thus they admit the use of most types of rewirable fuses, with a reasonable expectation of satisfactory service. An engineer may on occasion get some guidance by looking to see, or rather taking steps to find out, what the area board is using in their service fuse boxes. It is also a fact that the fault energy at 400/230 volts tails off rapidly with distance from the main switch or fuse board, and thus an engineer who prefers rewirable fuses on grounds of cost, or for any other reason may be justified in using them for sub-circuits.

I have had an opportunity of reading a draft specification for high voltage fuses, prepared by Mr Bryan Donkin's Committee of the B.S.I., which was recently circulated for comment and to one who remembers the Ferranti oil tray h.t. and other type fuses of past years the advance in the technique of construction is remarkable. When fault energy was, by comparison, low, a fuse wire laid along the bottom of an earthenware trough filled with oil could be trusted on high voltage switchboards although I think it was perhaps going rather far to connect such a type, as I once did, direct to 10 kV 3-phase busbars. It was one of those improvised afterthoughts and before the days of isolating switches, limiting resistances and such like frills, and I used to climb up to them with conscientious regularity to make sure the oil was still there and did not contain too many dead flies. I can say now with some truth that I was always careful not to touch anything.

With the gradual growth of fault energy Mr Pooley found a field of use for his h.r.c. fuses in the protection of the older types of "tin tank" circuit-breakers. I thought this a novel idea, but like some of the switchgear manufacturers, I had my doubts about it mainly because of the amount of improvising required to connect three h.r.c. fuses in a h.t. switch compartment designed only for a switch. Both Mr Pooley and Mr Vernon Hope had persuaded one or two friendly generating engineers to let them test their fuses by running up old alternators and creating short circuits and I believe these were the first attempts at performance testing. They were thus able to show that the fuses would operate cleanly and more quickly than many of the older types of circuit-breakers they sought to protect—the function of the latter being restricted to overload protection with time delay settings or relegated to hand operation for purposes of isolation. The economics were such that the cost of the additional h.r.c. fuses, with erection, was less than that of switchgear replacement but it was not easy to make a good job of fitting them in and there were difficulties about the time ratings of, and the stresses on, the current transformers.

(To be continued)

Cable and Capacitor Economics in Industrial Distribution

Part 2

By H. NIMMO, M.Sc., B.E., A.M.I.E.E.

ESSENTIAL factors in the design of an industrial distribution system are the cost of power and the load factor of the works. This article deals with the effect of these two variables on cable size, and in the present part it gives attention to the economics of power factor correction. In this connection, it considers the energy saving secured rather than the financial saving under a demand tariff. Thus it is applicable not only to concerns taking a public supply, but also to those which generate their own power.

Throughout the article a 420 V, three-phase 50 c/s supply is taken as the basis of all calculations. At the end of Part 1, the question was being introduced, how deeply in the distribution system should p.f. correction be connected.

The choice of position will be governed by the gain in connecting them deeper into the system, set against the loss occasioned by the extra capital charges arising from the increase in cost per kVAr of capacitors as their size decreases, since, the deeper into the system they go the smaller will each

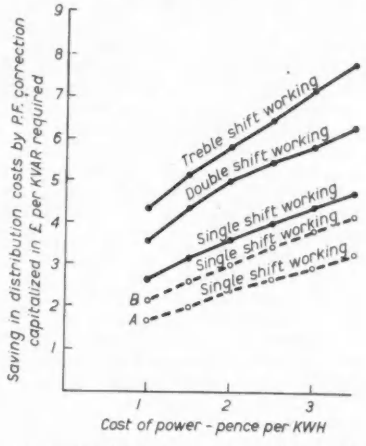

Saving in distribution costs by P.F. correction capitalized in £ per KVAR required
Treble shift working
Double shift working
Single shift working
Single shift working
Single shift working
B
A
Cost of power - pence per KWH

Fig. 5. Results of correcting from 0·7 to unity p.f. by capacitance at utilisation point. Broken lines show results with capacitance at end of primary distributors (A) or secondary distributors (B)

capacitor unit become. There is, however, an additional operational gain in connecting capacitors solidly in parallel with each power consuming device. If sufficient capacity is installed to bring the full load operating power factor approximately to unity, there is always a danger that the power factor of the whole system may become leading. This would occur if the lagging power factor load were disconnected as for instance normally occurs at the end of a day's work. In such circumstances, if the capacitors are not also disconnected, the power factor on the whole system will become leading, and the switching off or failure of the supply may easily cause excessive voltages to arise in rotating machinery. Such a possibility will be obviated if the capacitors are connected directly to the consuming device, since a reduction in load will be accompanied by a reduction in the amount of capacity in the system. The alternative method of ensuring that this swing to leading power factor does not occur, is to provide automatic control of banks of condensers, and this provision increases the capital charges on the correcting apparatus and also introduces maintenance costs. If, therefore, the configuration of the system will make it reasonably economical, the connection of condensers directly to the consuming device appears highly desirable.

In order to illustrate the possibilities of power factor correction at various stages of a distribution system, an ideal system will be considered in which the primary distributors carry 400 amps and are 150 yards long, each primary distributor feeds eight secondary distributors, each carrying 50 amps and each 44 yards long, and each secondary distributor feeds five final subcircuits carrying 10 amps and being 13·5 yards long. It might be remarked that these are the approximate average conditions of a large industrial system which has recently been carried out by the author. The load on this system was somewhat low in density, though not by any means abnormally so for a textile installation.

Location of Capacitors

Using the system mentioned in the last paragraph it will be easily possible to calculate the costs of distribution applying to each of its components. If the load has a power factor of 0·7 say, the cost per kW can be calculated from Table 10* and hence, assuming that the cost per kVA remains constant over this alteration the cost per kW at any other power factor can be deduced. This simple procedure has the defect that if, in an existing system, a corresponding physical alteration were made, the new, reduced currents may not be economically carried by the original low power factor cables and the system would require to be completely redesigned. The result of such redesign would be that the main distributors could remain unaffected since they would be designed to carry the same current though they would carry more power than before and there would be fewer of them. Secondary distributors would also be unaffected in current load and there would be the same number of them per main circuit so that there would be no change in the costs per kVA. Final subcircuits on the other hand would be greater in number, greater in length

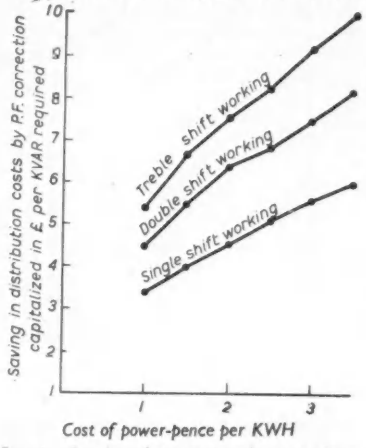

Saving in distribution costs by P.F. correction capitalized in £ per KVAR required
Treble shift working
Double shift working
Single shift working
Cost of power-pence per KWH

Fig. 6. Results of correcting by capacitors from 0·7 to 0·95 p.f.

on the average and would carry less current per distributor so that the costs would go up from both these causes. With a uniform floor distribution of load, it will be reasonable to assume that the average length of final subcircuits will increase in proportion to the square root of the total load so that an increase of load from 1·0 to 1·414 will correspond to an increase of length of 19% of the average feeder. This is the increase of load which corresponds to an improvement of power factor from 0·7 to 1·0. The increase in cost due to the corresponding decrease in the current carried by each feeder multiplied by the increase of length give a total variation of from 32% at low load factors and cheap power to 14·5% at high load factors and dear power. Since the costs in the final subcircuit is 16·9% to 10·5% of the total the whole error produced by this short method of assessment of the saving will range from 5·4% to 2·9%. It should be noted that the greatest error occurs when the power cost and the load factor are at their minimum.

The saving arising from power factor correction must of course be abated by the capital charges on the apparatus which must be installed to produce the correction and it will only be economic to correct the power factor to the extent that the saving so produced exceeds the charges on the apparatus producing it. It will therefore be most useful to relate the saving to the capital value of the plant

* Included in Part 1.

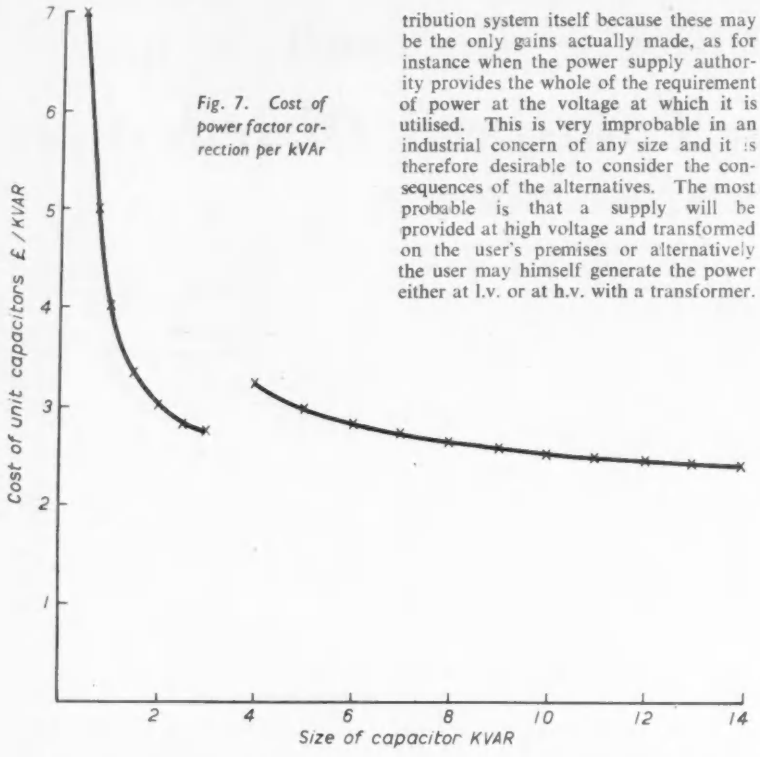


Fig. 7. Cost of power factor correction per kVAr

which can be paid for by this saving. A series of calculations of the capitalised value of these savings has been produced using the costs of power and the load factors for which most economical cables were earlier determined and with the physical layout of the ideal system mentioned above. The results so obtained are shown graphically in Figs. 5 and 6. Fig. 5 shows the result of correcting to unity power factor and Fig. 6 to 0·95 lagging power factor. It will be noted that correction to 0·95 only gives a much greater capitalised saving per kVAr required and therefore will justify the purchase of much more expensive capacity for that purpose. This of course was to be expected, since it requires 102 kVAr to correct from 0·7 to 1·0 and only 68·9 kVAr to correct from 0·7 to 0·95 per kW. It should also be pointed out that these curves are non-continuous functions and cannot be relied upon for interpolation.

The broken line curves given, show the saving at various stages of the system and it will be noted that even under the worst conditions, that is minimum load factor and full correction to unity the saving in the final subcircuit capitalises to about 10/- per kVAr which should be sufficient to absorb the difference in capital cost between the small bulk capacitor which might be installed on an individual distribution board and a 4 kVAr capacitor which might be installed on a motor about 6 h.p.

Overall P.F. Correction

Consideration has, up to now, been given only to gains arising from the distribution system itself because these may be the only gains actually made, as for instance when the power supply authority provides the whole of the requirement of power at the voltage at which it is utilised. This is very improbable in an industrial concern of any size and it is therefore desirable to consider the consequences of the alternatives. The most probable is that a supply will be provided at high voltage and transformed on the user's premises or alternatively the user may himself generate the power either at l.v. or at h.v. with a transformer.

In either of these cases there will be a copper loss in the transformer or generator or in the transformer and generator, and these copper losses will be minimised by improving the power factor. Assuming that the copper loss in such apparatus is between ½% and 1% of the normal rating we find that the capitalised value per kVAr of capacitor to effect the correction from 0·70 to unity ranges from £0·234 at ½% loss and 1d. per kWh to £1·64 at 1% loss and 3½d. per kWh with single shift working, from £0·464 to £3·28 with double shift working and £0·702 to £4·92 with treble shift working and correspondingly increased values for correction only to ·95.

Such additional savings should be added to those found for the distribution system to determine whether or to what extent it is desirable to correct power factor on the whole installation. If it is found that the gain in the distribution system does not justify correction to unity but the addition of the gain in the transformer and/or generator will justify going to unity, it may well prove an attractive proposition to correct to ·95 at motors and from ·95 to unity by a bulk capacitor connected to the l.v. board. These capacitors, however, would require to be automatically controlled to prevent the power factor swinging to leading when the load fell.

Cost of Capacitors

As has already been mentioned, the only obstacle to the use of unit capacitors directly connected to the motors whose power factor it is desired to correct, is the heavier cost per kVAr of the capacitors as the size is reduced. Fig 7 shows the way in which the cost per kVAr varies with the rating of the capacitors as the size is reduced. The information on which this curve has been based has been supplied by the courtesy of Messrs Standard Telephones and Cables Ltd. The values shown on the curve should represent the approximate cost of small capacitors up to 14 kVAr.

No fixed relationship exists between the h.p. of a motor and the capacitance required to be connected in parallel with it to bring the loaded current to any specific power factor, but for any induction motor the lagging reactive current is substantially constant over its power range and it will be found reasonably satisfactory to provide capacity of sufficient rating to supply the reactive lagging current of the motor at ¾ load. This will give fairly near unity power factor over the whole power range of the motor.

From Fig 5 the capital sum available for the purchase of capacitors at the cheapest rate of power, viz 1d. per kWh, is £2·62 for single, £3·52 for double and £4·33 for treble shift working if correction is brought up to unity. These sums are sufficient to purchase condensers of ratings not less than 9 kVAr for single, 1·5 kVAr for double and 1·0 kVAr for treble shift working. A 1·5 kVAr might be supposed to be appropriate for a motor of about 2½ h.p. It is therefore a reasonable assumption that it will always be worth considering the provision of condensers on all motors, and that it will prove to be an economic proposition on all installations unless the load factor is very low, power is very cheap and the motors are very small. It should be clearly understood that the words " an economic proposition " in the last sentence refer only to the internal economics of the distribution system. If power is supplied on an agreement which reduces the cost of power as power factor approaches unity, the gains in economy considered here are in the nature of an additional bonus which will only be slightly diminished by the capital charges on the differences in the cost between unit capacitors and automatically controlled bulk capacitors.

Conclusion

It will be seen that the selection of cables in an industrial distribution system depends primarily on the cost of power and the load factor of the completed installation. Due regard being paid to these two factors, it will be found more economical to distribute with as heavy loads as possible, provided that this does not at the same time increase the length of the final subcircuits.

With regard to power factor correction it appears that there will generally be a case for installing power factor correcting apparatus as deep in the system as possible and for operational reasons the installation of unit capacitors looks very attractive especially in high load factor installations.

Planning a Works Distribution System

Part 3 Protective Gear

by a Steelworks Electrical Engineer

SOME observations have been made in preceding articles* on factors which have a bearing in the choice of voltage and method of layout of works electrical networks. The following paragraphs refer primarily to protective gear, which when correctly applied can make a major contribution in maintaining the supply.

The function of protective gear is to guard against the operation of the protected equipment under dangerous conditions by disconnection of the circuit, by energising an alarm device, or by setting into motion apparatus which will automatically correct conditions to safety.

Protective Gear— General Applications

Protective gear is unique amongst the various types of electrical equipment in that the major portion of its working life is spent in an inoperative condition, and the occasions when operation is required are separated by prolonged intervals of time. A system of routine testing to check that the gear is in working order is therefore essential, and this point cannot be too strongly emphasised. Unless the works engineer is prepared to face the costs of testing equipment and of the time required for carrying out tests there is really no point in providing anything but the most rudimentary protection.

In this connection it is worth noting that Continental practice strongly favours direct-operating overloads on indoor switches for all voltages up to 15 kV. The absence of current transformers and the extreme simplicity and robust construction of the overload mechanism makes complicated testing routines unnecessary, and the cost of the gear is appreciably reduced. With this arrangement, however, it is difficult to ensure discriminative operation of switches under fault conditions and a fault on an outgoing feeder may shut down a large portion of the network; such shut-downs will be relatively infrequent and the effects may not be serious enough to justify the installation of more advanced protective gear. Dependent on the industrial process involved, a case may, therefore, be made for the omission of current-transformer operated relays which involve not only a high capital cost, but also appreciable maintenance charges.

H.V. Feeders

H.V. feeder protection has been extensively developed for supply and distribution authorities, and a mass of published material is available to assist the works engineer in the choice of a suitable system. The more elaborate types of pilotless zoned protection are intended for main transmission circuits when the route lengths make pilot cables technically or economically undesirable; for works use the decision will in general rest either on the well known Inverse Time, Definite Minimum relay or some form of zoned pilot wire system using relays which incorporate an automatic bias feature to render the gear inoperative for through faults.

The induction disc type of relay gives the familiar inverse time curve, and this gear, when properly maintained, can be relied on to give satisfactory operation with time gradings of 0·5 second or slightly less between successive relays. Zoned protection can be arranged to give very short operating times, and since the discrimination is independent of the magnitude of the fault current, the clearance time can be maintained irrespective of the position of the zone in relation to the remainder of the network.

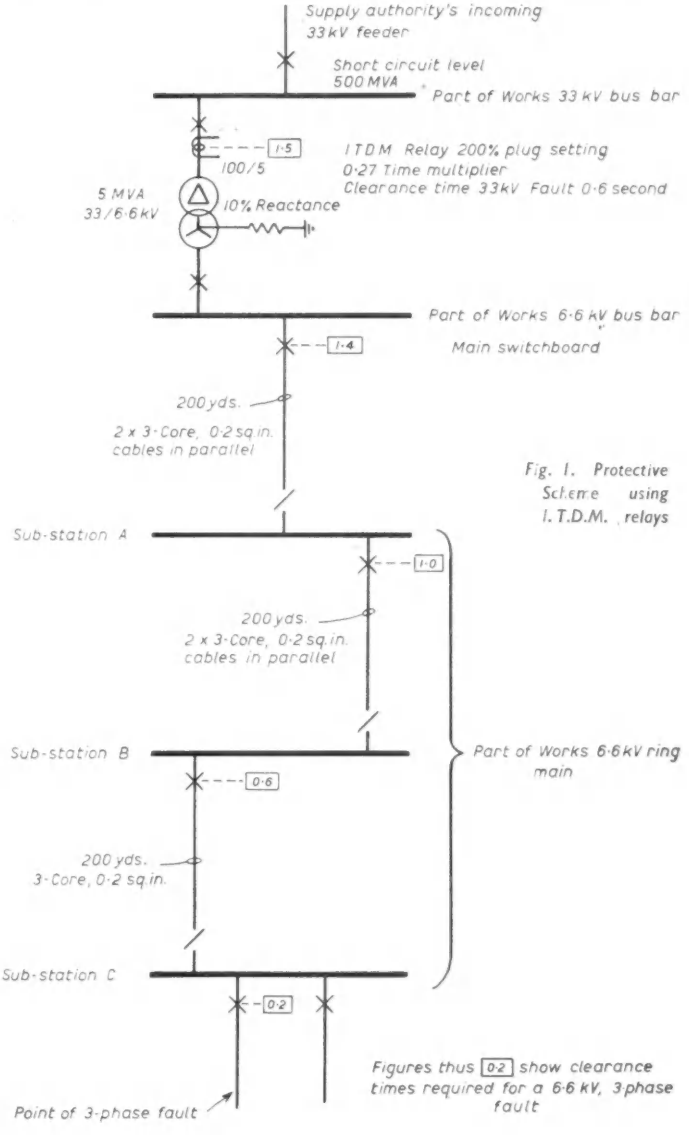


Fig. 1. Protective Scheme using I.T.D.M. relays

**Industrial Maintenance, page 1, 21 Jan., 1954, and page 21, 18 Feb., 1954.*

It is common practice to provide an I.T.D.M. relay as "back up" protection for a zoned system so that in the event of failure of the restricted protection the back up relay will operate to clear the fault, the clearance time, of course, being considerably longer than that of the "first line" protection. In the author's opinion this principle is of doubtful validity when applied to works networks. If the pilot wire protection cannot be guaranteed to operate it would appear justifiable to rely on the I.T.D.M. relay in any case, and not install the more costly zoned protection at all. It is of course true that a feeder fault may also damage the pilot cable, particularly with underground systems, but this would seem to be an argument which favours equally the installation of back-up protection or the abandoning of the restricted system. The operating statistics of supply authorities show that at least 85% of system faults can be expected to be correctly cleared, and the major proportion of this figure is made up of "first line" protective gear operations.

Conditions in a works network are not those which obtain in a large interconnected system when protective gear maloperation may have widespread and disastrous results, and it is therefore suggested that back up protection be employed only on main incoming works feeders and that outgoing circuits be protected either by a zoned system or by I.T.D.M. relays. The capital and maintenance charges of two sets of C.T.'s and relays to protect one circuit will then be avoided.

Relay Settings

Information on the selection of relay settings and the calculation of fault currents is readily available and it is not proposed in this article to reiterate the principles involved. It should however be appreciated that with I.T.D.M. relays complete discrimination throughout the network cannot always be obtained, and Fig. 1 is an illustration.

If the arrangement of the supply authority's 33 kV system is such that a fault on the works 33 kV system will operate the back-up relay at the supply end in 1 second, the transformer 33 kV should not have an operating time greater than 0·6 second in order to guarantee discrimination in the event of a fault on the 33 kV side of the transformer. The setting figures shown in the diagram will achieve this end. The impedance of the cable between the main busbars and substation C is so low in comparison with the fault infeed reactance that a fault close up to one of the outgoing switches at this substation, as shown, will produce almost the same fault current through the transformer as a fault on the main 6·6 kV busbar. If the outgoing switch at C is set to give the minimum operating time of 0·2 second, the clearance times of the other switches will have to be as shown in order to secure discriminative operation of the gear. However, a three-phase fault at the point shown will result in a current of just under 800 amp in the 33 kV transformer switch and with the setting previously determined this switch will clear in 1·5 seconds. It is not, therefore, possible to guarantee that a 6·6 kV feeder fault will not clear the transformer on the 33 kV side since the discriminative time interval is insufficient.

The obvious solution is to alter the c.t. ratio on the 33 kV switch to a higher value, say 300/5, and utilise the inverse time portion of the relay characteristic to ensure discrimination for 6·6 kV faults. This may not always be possible and when such cases arise the best alternative is to abandon the discrimination

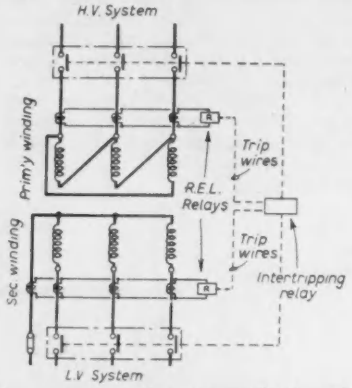
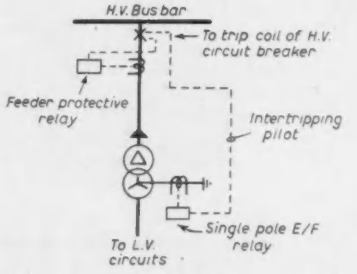


Fig. 2(a) above illustrates restricted earth fault protection on both sides of a transformer, and 2(b) below, an elementary form of transformer feeder protection



at the outlying parts of the system, and to obtain it near the main switchboard when mal-operation would have a more serious effect.

L.V. Feeders

The use of current transformers and relays for outgoing l.v. feeders is very rarely justifiable, and if circuit-breakers are in use direct acting overloads with some form of adjustable time lag will normally be adequate. A large proportion of l.v. power circuits are, however, protected by h.r.c. fuses which can be very accurately graded with the assistance of the manufacturer's characteristic curves. Fuses of this type can be used on all l.v. circuits when normal fault levels prevail and since the speed of extinguishing the arc is faster than the rate of growth of current the fuse will actually interrupt the circuit before the fault current has reached its full prospective value. By this means fusegear may be selected on the basis of the full load current of the circuit rather than on the current which will flow in the event of fault. It is because of the current "chopping" characteristic that it is possible to connect a 5 amp fuse of very small physical dimensions to a circuit of 25 MVA fault level and still obtain satisfactory clearance.

Transformers

One of the most useful forms of transformer protection is the float-operated relay which is arranged to trap any gas generated in the oil-immersed transformer windings or core. A relay of this type will give warning of incipient faults, and may thus obviate the repair bill which will result from a major fault in the transformer. On very large units thermal models are employed to trip the transformer in the event of the windings reaching an excessive temperature.

Purely electrical protection may be provided by an overall restricted scheme which compares the h.v. and l.v. currents and operates if these two quantities differ from the figure determined by the transformer ratio. If tap-changers are fitted, as is usually the case, the protection will include a bias feature to take care of the different ratios of transformation which result from adjustment of the taps.

It is not sufficient for complete protection of a transformer to fit devices on one side only; for example a delta/star step-down unit may develop a l.v. fault close to the star point serious enough to destroy the transformer, but not producing enough current on the delta side to operate the h.v. protection. A comprehensive scheme must therefore protect both sides and trip both switches, and an intertripping relay, actuated by the protection on both the h.v. or l.v. side is usually provided for this purpose. The overall protection scheme, as already mentioned, may involve a bias feature and if this is considered undesirable the primary and secondary windings may be treated as separate units each with its own restricted protection, each protective group clearing both sides of the transformer via an intertripping relay. Since a phase-to-phase fault clear of earth is most unlikely in a transformer winding, restricted earth leakage protection may be used on each side as shown in Fig. 2(a).

Where transformer feeders are concerned similar considerations apply, and the h.v. cable is included as part of the transformer h.v. winding.

The transformer is inherently a most reliable piece of equipment and for the smaller units protection may be simply by fuses on the h.v. side. An elementary form of transformer feeder protection is shown in Fig. 2(b), where the l.v. winding is covered only by a relay actuated by the current in the neutral. This is, of course, unrestricted protection and can be used with advantage if the transformer l.v. switch is omitted; a sustained fault on an outgoing feeder if not correctly cleared, will then operate the neutral relay and shut down the h.v. side of the transformer.

(To be continued)

Electrical Measurements aid Mechanical Engineering Design

THAT the application of electrical measuring techniques to other branches of engineering is by no means fully exploited was demonstrated at last week's I.E.E. Measurements Section meeting by three papers describing electrical methods of determining mechanical engineering design data. Electrical methods may not only prove superior by simplifying procedure or giving higher accuracy but often provide the only means of obtaining reliable information under certain conditions. Such was the case in the determination of the static and dynamic elastic properties of resilient materials, described by R. S. Jackson, GRAD.I.E.E., A. J. King, M.SC.TECH., D.SC., F.INST.P., M.I.E.E., and C. R. Maguire, B.SC., A.M.I.E.E.

The use of these materials for reducing structure born noise and vibration has increased considerably during the last decade making the need for reliable information of their performance a prime necessity. As the static stiffness and dynamic stiffness could differ by as much as ten times, static compression data could not be regarded as sufficient additional information of materials' performances under conditions of vibration being thus required. Moreover, the need for knowledge of the performance of these materials in the transition from dynamic to static behaviour gave rise to a number of experiments over a wide range of materials, frequencies and loadings.

Method of measuring performance

The method initially employed a somewhat large machine but due to small samples, of the order of 1 in. cube, only being available a smaller unit was constructed. In both cases moving coils were used for vibrating the sample and measuring the movement transmitted through it. The major problem, however, lay in the requirement to trace the variation of elastic properties down to zero frequency, which involved the generation of ultra low frequencies. After several attempts, the most suitable method was found to be that of revolving the brushes of a 3 amp, 100 V d.c. machine. Its two brushes were mounted on a "Bakelite" disc running on ball bearings, and driven by a pulley and belt arrangement from a velodyne. In this manner it was possible to attain a frequency of 1 cycle in 10 mins. Detection of the output, down to 1 c/s, was effected with a modified feedback analyser, and below this frequency by displacement methods, viewing the movement of a slit of light on a piece of smoked glass attached to the oscillating block through a microscope fitted with an eyepiece scale.

Experiments were made with silicone and butyl synthetic rubbers, various samples of other rubbers, natural cork and glass wool, measuring dynamic stiffness, magnification and static and incremental stiffness. The first objective of the work—to fill in the gap between dynamic and static stiffness — was successfully accomplished, clear pictures of the performance of these materials being obtained over a frequency range of 6 c/hr to 3 kc/s. Moreover, the work showed that frequencies at which wave motion occurs in the samples (which were generally of a size similar to those of resilient mountings) is of the order of several kc/s, with the transmitted force at these frequencies rising to seven times its l.f. value.

In the paper by D. Hadfield, M.SC.(ENG.), A.M.I.E.E., the advantage of electrical methods was seen to lie in the ability to examine specimens under production conditions, in this case the magnetic measurement of mechanical hardness of a 1% carbon, 1·3% chromium steel. Mechanical testing of hardness involves either the destruction or damage of the specimen, thus precluding thorough inspection of articles under production. Although the principle of magnetic testing of mechanical hardness was established about a century ago, the paper demonstrates a direct relationship between magnetic permeability and mechanical hardness of this particular steel, which was available for test in the forms of a six-pounder armour-piercing shot and of a steel bush used in the crank end of the piston rod of a motor cycle engine.

Most of the work in the paper relates to the shot, the problem here being brought about by the decrease in hardness of the metal from the surface to the core. Satisfactory hardness of the outer zones masks any variability in the centre zone, of which both size and hardness are unknown. The equipment used was based on that described in B.S. 406: 1931, comprising two soft iron pole pieces adapted to receive the shot, mounted on two "Permalloy" blocks between which rotated a soft iron disc. Collecting brushes, arranged to make contact with the copper-rimmed periphery of the disc, and with the spindle, were connected to a voltmeter, while the shot placed between the pole pieces was energised by direct current flowing in a coil wound round it.

Measuring the Hardness of Shot

Using standardised shot supplied by the N.P.L. and shot taken from the production lines, magnetic and mechanical hardness tests were made, attention, in the magnetic tests, being devoted to the first quadrant of the hysteresis loop and to the normal magnetization curve. Initially experiments were performed with laboratory equipment but a portable test set was designed to enable testing to be carried out on the production site. Results indicate a clear relationship existing between the mechanical hardness and magnetic permeability, such that the apparatus was capable of measuring the mean volumetric hardness of the specimens tested (both shot and, later, steel bushes).

Whereas the previous papers described methods employing d.c. or low frequency a.c., the remaining paper, by N. C. de V. Enslin, described two methods of employing microwave resonance to measure small displacements, applying this principle to the measurement of torque in shafts. Essentially, both methods are alternative means of using a resonant cavity. In the simplest form of cavity, which consists of a closed end cylinder whose volume may be varied by an adjustable plunger, a given volume will resonate at certain fixed frequencies. At this point, the resonance is extremely sensitive to small changes in volume, so that if the position of the plunger be displaced by a small amount from the resonating position, this change will be marked by a sharp fall in the power output of the cavity, provided the r.f. power input remains constant. Using a specially designed cavity of two halves mounted on a revolving shaft so that torque in the shaft can be made to alter the axial distance of one half from the other, the same principle may be employed, by either method, to measure the torque to within ±1%.

A New Network Analyser

Recent British Installation Operates on Unusually High Frequency

RECENTLY installed at the Reyrolle works is a network analyser which has been built for the study of power-system problems such as voltage-regulation, load-distribution, synchronous stability and fault calculations. This particular unit is of the impedance type in which the actual impedances of the system under investigation are represented by equivalent impedances in the analyser, and thus differs from the analogue type, such as the Blackburn, in which impedances are represented by the ratios of transformers. As, however, with most analysers, the Reyrolle plant is not confined to the solution of electrical problems, but can be set up to carry out investigations into physical and mechanical problems, where they can be represented by an electrical analogue. A particular feature is that the analyser can be used for transient studies such as rates-of-rise of restriking-voltage.

Although basically, the analyser follows conventional lines, the frequency chosen for its operation is unusual in that it is 1,592 c/s, instead of the more general 500 c/s, and due to this, differences have arisen in the design of the units and in the methods of connection.

As can be seen from the photograph, Fig. 1, the machine occupies three sides of a room, and has a centrally disposed control desk. Four marshalling or interconnecting cubicles are provided, and the impedance units are racked into the side and rear panels. At the top of these panels are the load voltmeters, and immediately below them are three sets of line units, below these again are the load units, and the last two items are the auto-transformer and the capacitance units. Generator units are carried on the control desk itself.

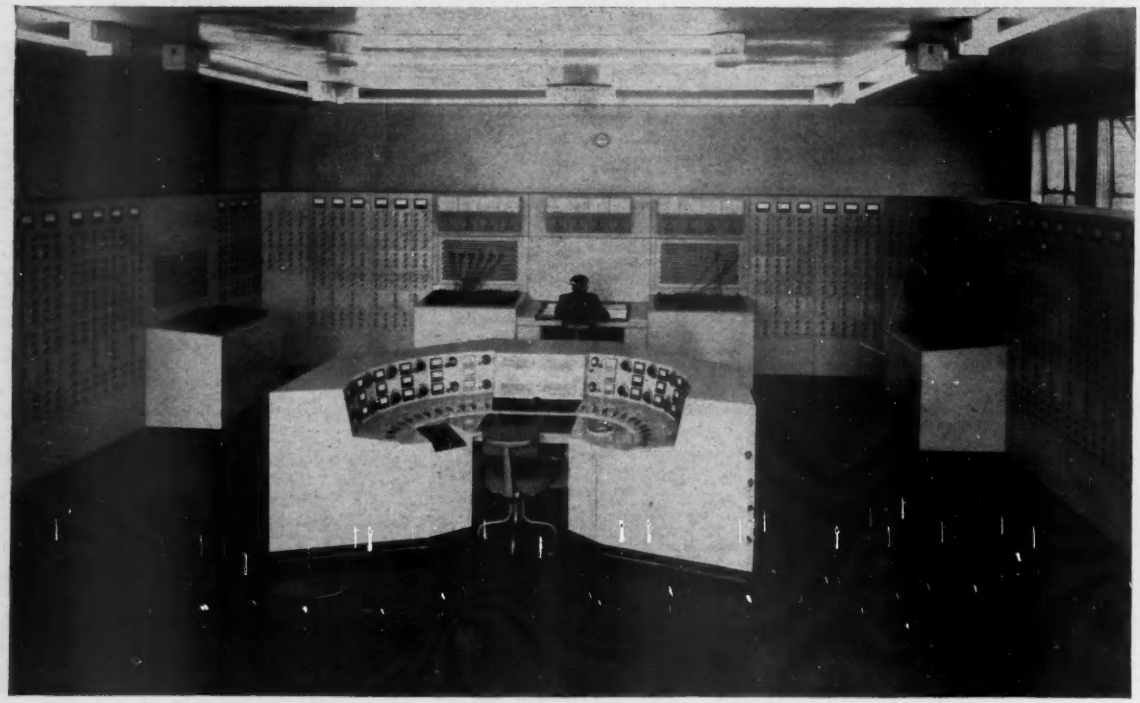
Altogether, the equipment comprises 12 generator units, 120 line units, 36 load units, 36 auto-transformer units and 72 capacitor units. Sixteen of the 36 load units have built-in auto-transformers and each load unit has a load voltmeter associated with it. These units, with the exception of the generating units, are arranged in four groups, each of which has its own marshalling cubicle. The twelve generator units may be switched to any of the four marshalling cubicles and there inserted into the system as required by the problem.

All main metering is done from the control desk which accommodates five master instruments—an ammeter, a wattmeter, a varmeter, and a phase-angle indicator, and these master instruments can be connected into any part of the system being studied by a metering selector system operated from the control desk.

Generator Units

The main source of supply to the analyser is derived from a valve-maintained tuning fork which produces an accu-

Fig 1. General view of analyser and control desk illustrating the arrangement of units. The four marshalling boards are for interconnection of units



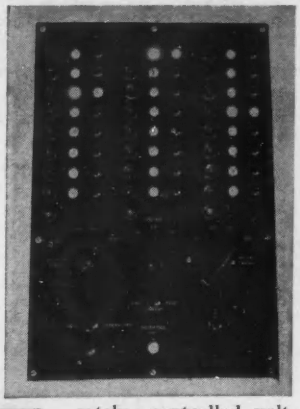
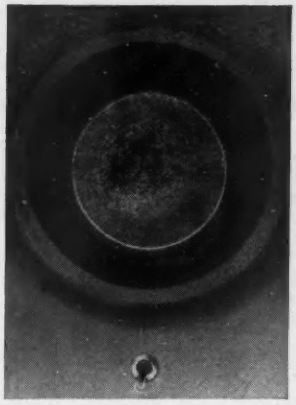


Fig. 2. The selector panel (right) permits measurements to be taken on any unit by pushing the appropriate code buttons

Fig. 3. Phase "angles" can be read directly from the face of a cathode ray tube (below)



rately - controlled voltage at 1,592 c/s. This is a single-phase source and is fed into a phase-splitter to give a two-phase output. The output is fed into twelve continuously variable phase-shift devices, the single-phase outputs of which are in turn fed into continuously variable voltage transformers. Thus, at the output terminals of the voltage transformers there are available twelve sources of supply of variable phase and variable magnitude. Each of these sources feeds into an output-amplifier of special design, having a very low output impedance, and from the amplifier into the generator impedance units. Each generator unit has its own monitoring wattmeter, voltmeter and varmeter alongside the phase angle and voltage controls.

The other units are fairly straightforward. Line units consist of adjustable inductance and series resistance; capacitor units—which can be either series or shunt connected—represent line or cable capacitance, synchronous condensers or bulk capacitors; load units consisting of resistance and inductance for shunt connection, and auto-transformer units which simulate tap-changing operations.

Setting-up

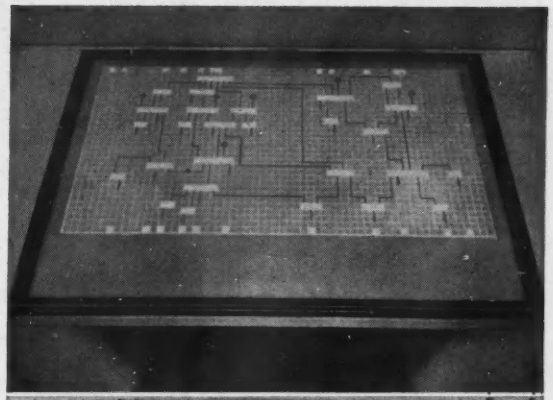
The various units terminate at the marshalling boards in 3-pin plugs connected to flexible leads, and these can be inserted into sockets as shown in Fig. 5. In order to connect two units, their plugs are simply connected into adjacent sockets, and a row of plugs in adjacent sockets represent a busbar. Two of the pins serve to connect the units, while the third illuminates a lamp on a mimic diagram appropriate to the position in which the plug has been placed. The fact that the appropriate unit has been plugged in the correct socket can be checked by the dimming of the lamps associated with the unit when this is selected on the metering selector panel.

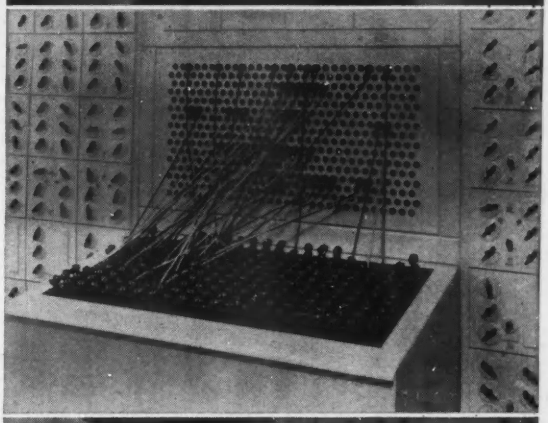
When setting up a problem on the analyser, it is first necessary to obtain a system-diagram and to mark on this all relevant voltages, equipment ratings and impedances of components. The data is then used to draw a schematic system-diagram on translucent paper which is placed on the mimic diagram table and which registers with the indicating lamps. The units to be used in the study are adjusted to the required values, and plugged in on the marshalling boards.

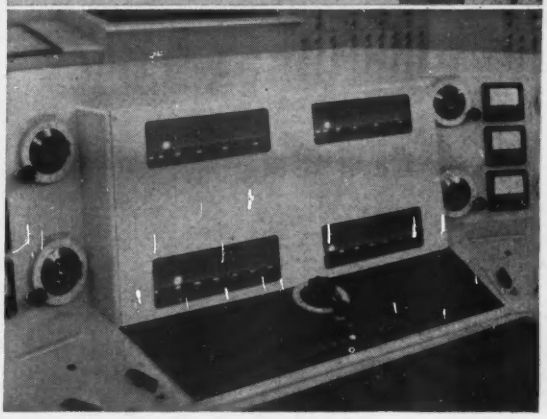
Of the five master instruments, four are dynamometer instruments with light spot indication, the fifth being a phase angle indicator. This is a cathode-ray tube with a scale marked in degrees on its screen. Indication is by "pips" on a circle which show the phase-relationship between voltage and current of any unit being metered with respect to each other or to some arbitrary reference.

On the left-hand side of the desk is a panel which controls the metering selection and range change for the master instruments. Each unit in the analyser is identified by a three-digit number, and the master meters may be connected to any unit by pressing out the appropriate number on the panel.

Fig. 4. Setting up is greatly facilitated by the mimic diagram board
Fig. 5. The marshalling plug panel (below) connects units and reproduces the connections by bringing up lights on the mimic diagram
Fig. 6. Readings are taken on the master instruments on the control desk







E.D.A. Notes a Crowning Year

IT is gratifying to record a crowning year for the Association—a year that opened with promise and closed with fulfilment. So begins the 34th Annual Report of the Electrical Development Association, which was presented at yesterday's annual general meeting; and the events recorded for 1953 fully justify the sentiment. The opening continues, "Resurgence characterised almost every branch of the Association's activities which, in turn, is clearly reflected in the consistently growing demand for electric service and electric appliances of all types."

Amongst the organisational developments noted is the formation of a B.E.A./Area Boards/E.D.A./B.E.A.M.A. Joint Policy Council, whose object is to establish at the highest level the policy and objectives to be pursued in the common quest of electrical development.

E.D.A.'s film making continued, with authorisation of four more films, on smoke abatement, kitchen planning, cooking, and industrial planning. The film library issued 14,880 copies of films compared with 13,819 in the previous year. Exhibition activity continued on a large scale, and in this respect, it is noted that the permanent display at the London Building Centre will be entirely revised at the earliest opportunity. Advertising and publicity concentrated on the promotion of cookers and water heaters, under a new slogan, "Electricity—a Power of Good."

One of the important tasks of the year was the preparation, at the request of the Ministry of F. & P., of a list of domestic appliances which would be recommended to local housing authorities. The first edition of this list included only appliances which had been approved by all electricity boards. Now, however, a special testing and approvals committee has been set up, and this will deal with new additions to the list. A revised, and fuller, second edition is expected to appear shortly.

In the domestic field, attention was given to the effect of synthetic detergents on electric washing machines, and it was decided to produce a leaflet advising the user how to take care of the machine. During the year, reports on field tests of aluminium kettles were received, from which it appears that corrosion troubles are being overcome. The refrigeration committee reviewed the development of the domestic refrigerator load, including the possibilities of larder cooling units which would also provide a reasonable amount of water heating.

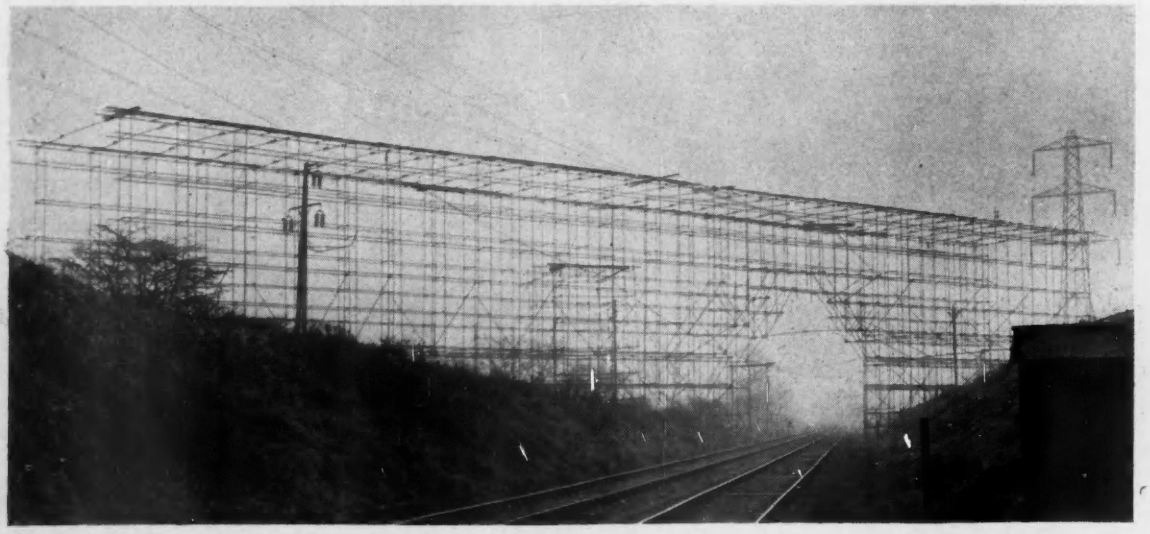
In October, the new Testing House at Leatherhead was officially opened by the President of E.D.A., Sir Henry Self. Altogether, the establishment issued 104 reports on new apparatus and investigations. In addition to its work on specific appliances, the Testing House continued to investigate problems associated with testing techniques.

Stringing a 275 kV Line

WHEN it is necessary to erect one high-power line to cross an existing installation, it is generally possible to arrange for the line to be crossed to be made dead while the other conductors are erected and tensioned. Such a procedure could not, however, be carried out when the engineers of British Insulated Callender's Construction Co., Ltd., engaged on the erection of the Stella-Thirsk section of the 275 kV Supergrid, had to cross a 66 kV overhead line. No less than thirteen cables had to be drawn across and it was estimated that this would take at least four days to complete. Such a prolonged shut-down on the 66 kV line could not be tolerated. Recourse had therefore to be made to protective scaffolds, and these were erected by Scaffolding (Great Britain) Ltd. for B.I.C. Construction Co. The scaffolds were 240 ft long and 50 ft high, and were built around the two sections of the 66 kV overhead line, thus affording full protection.

At one of the crossings it was found that not only did the 275 kV line cross a 66 kV line, but that at the point of intersection the 66 kV line passed over a two-track railway cutting. In this case, a large arch spanning the cutting was included in the structure of the scaffold.

The 240 ft scaffold spanning a railway cutting. The 66 kV line pole can be seen on the left protected by the scaffold



URANIUM PRODUCTION

Electric Furnaces for Providing Pure Metal

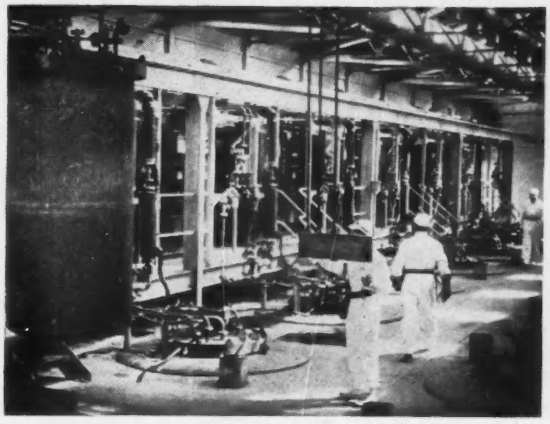
DUE to security reasons, the announcement has only recently been made of the large part played by the General Electric Co. in the provision of equipment for the conversion of pure ammonium diuranate to metallic uranium. It may be recalled that in our digest of "Britain's Atomic Factories" (ELECTRICAL TIMES, 21st January, 1954) we gave a short description of the chemical processes involved. The particular part played by the G.E.C. furnaces is of major importance. The diuranate is converted to metal in two stages; in the first it is converted to pure uranium tetrafluoride by heating the diuranate in the electric furnaces, reducing it and then passing over hydrogen fluoride gas at the appropriate temperatures. This results in the formation of solid uranium tetrafluoride. This is taken from the furnace, mixed with chips of calcium metal in a mould and then fired, resulting in its reduction to uranium metal. Some difficulty was originally found with corrosion of the furnace linings and pipes but this has now been overcome by using Inconel.

Final Reduction

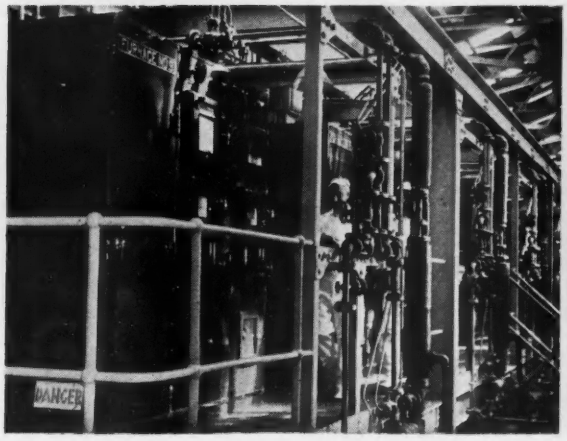
The final reduction reaction is the most dramatic part of the whole production process. The mixture is put into a mould contained in a steel pot. After full safety precautions have been taken, the mixture is fired by an operator. Once started, the reaction is watched by the operator who sees through thick green glass, the red glow in the centre of the mould build up to white hot incandescent mass. When the reaction is complete, a cooling mass of uranium is left for several hours, when it reaches a temperature sufficiently low to permit withdrawal, and the heavy uranium billet is then removed. A small quantity is drilled out for analysis and after the analysts have verified that the uranium is up to specification the billet is taken to another building where the metal is remelted in an electric furnace and run out into moulds to make rods suitable for casting. This casting is done under vacuum by a method developed by Harwell and the Development Branch at Springfields in collaboration.

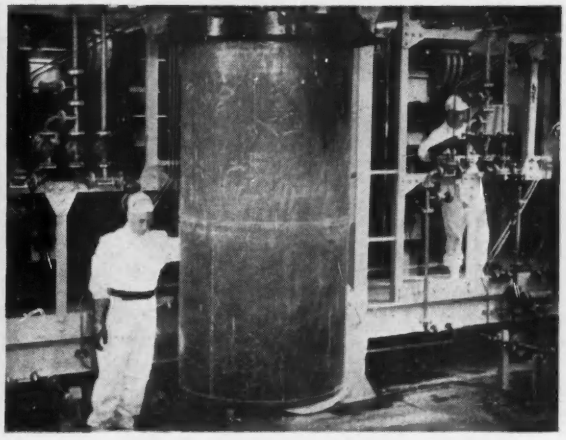
The G.E.C. order, amounting to some £500,000, was placed by the Ministry of Supply, and comprises 54 vertical cylindrical furnaces, each rated at 100 kW, and 200 furnace pots. It is believed that this is the largest order ever placed for furnaces at one time in any part of the world. Auxiliaries included were containers, control and unloading gear and cranes. The heated depth of the furnaces is 6½ ft, and the maximum temperature is 750° C. Forced air cooling is provided both for furnaces and charges. The furnace pots have a diameter of 3 ft 5 in. and a depth of 7 ft 1 in.

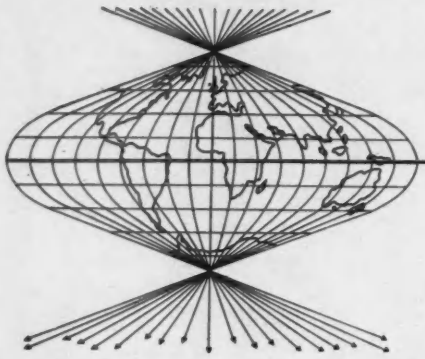
A bank of the furnaces is shown in this view



Left, some of the 54 electric furnace control panels and (right), a furnace pot holding pure ammonium diuranate which is converted in the furnaces to uranium tetrafluoride







OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

CANADA

Saskatchewan's Plans

An extension of the Estevan-Weyburn transmission line to Regina and Moose Jaw, Saskatchewan, to be completed this year, would result in less power being purchased from these two cities by the Saskatchewan Power Corporation, Mr J. A. Darling the Works Minister, announced in the Provincial Legislature recently. That project would cost almost $1,000,000, while another line from Estevan to Moosomin as an alternative source of supply to the Yorkton-Melville-Canora area would cost some $700,000. He said the forecast of Saskatchewan's power needs over the next 10 years showed a generating capacity of 440,000 kW would be required in 1964, compared to the 140,000 kW demand in 1952. The South Saskatchewan River project and the Fort a la Corne hydro development would not be capable of meeting the demand in themselves, even if those projects were proceeded with in this period. He said some $3,250,000 had been spent on British equipment in various plants of the Power Commission.

Expansion in Quebec

The Quebec Power Co. proposes to spend between $2 million and $2¼ million in each of the next five years for expansion of its services, Mr J. A. Fuller, president of the company, has stated. The company, which also operates a gas and transport service in the city of Quebec, last year sold over 616 million units to its 99,266 electricity consumers. The maximum system demand was 149,175 kW. Average annual use of electricity per residential consumer amounted to 2,273 units, an increase of 11%.

Manitoba's Finance Provisions

The Provincial Government intends that the Manitoba Hydro-Electric Board shall dispose of its distribution responsibilities in Greater Winnipeg. Further evidence of this was given when the $41 million Supply Bill was introduced in the Legislature recently. Of that sum $21½ million is for the Manitoba Power Commission, of which about $15½ million is to enable the Commission to take over the distribution facilities of the Winnipeg Electric Co. if the city itself does not accept the government's offer to purchase that portion within the city (to which we have already referred). Should the Winnipeg City Council accept the offer it must turn over to the Manitoba Power Commission its distribution facilities in Transcona and East and West Kildonan, in which case the $15½ million earmarked in the Supply Bill would not be required. But if the city rejects the offer, the Power Commission will acquire the company's system inside and outside Winnipeg, leaving the city to carry on as at present, and for this the $15½ million will be required. The balance of $6 million voted for the Power Commission is for the completion of the rural electrification programme. The Supply Bill also allocates $12½ million to the Hydro-Electric Board, which will cover expenditure on the McArthur Falls project and for the purchase of turbines and other equipment for the new Brandon steam station, although it is not expected that actual construction work will start on the latter station this year.

COLOMBIA

Scheme for Underground Railway

The municipal authorities in Bogota, Colombia, are planning the construction of an underground railway. The idea, apparently, is that the concern which undertakes construction of the project would be granted a charter to operate the railway, together with adequate guarantees against any future nationalisation or expropriation. But on its part the construction company would have to provide the capital and technical means for the job. Bogota, which is some 8,660 ft above sea level, has about 600,000 inhabitants, but that figure is expected to be double within a few years as the result of the establishment of new industries.

WEST INDIES

Further Expansion

The San Fernando Borough Council is to be given a loan of $300,000 from the Trinidad and Tobago Government to be spent on improving their electricity distribution system. Of that sum, the Government has released $69,000 immediately to permit the laying of new mains and installation of equipment to supply energy to the new Colonial Hospital and the Technical College, which work is to be undertaken by the Trinidad and Tobago Electricity Commission.

EUROPE

Consumption in Portugal

Data of electricity consumption in the Lisbon and Oporto areas, just published, show that in Lisbon, where there is also a gas undertaking, 253·4 million units were consumed, while in Oporto, which is without a gas supply, 272·3 million units were sold. Domestic consumption amounted to 60 million units in Lisbon and 107·7 million units in Oporto, it is stated.

Railways in Greece

Discussions have recently taken place in Greece concerning an extension of the Athens-Piræus electric railway northwards from Athens to Kifisia. Plans for such an extension were drawn up some time ago, but it is now reported that the Greek Government has agreed with an American mission on the loan of $1·3 million to the company out of U.S. appropriations and has also earmarked $2 million of German credits for the purchase of rolling stock and signalling equipment. The total expenditure involved in the extension is estimated at approximately $6 million.

MIDDLE EAST

Progress in Turkey

Work is well advanced on the 60 MW extension of Turkey's Catalagzi steam-power station, for which the main contractors are Metropolitan-Vickers Electrical Co. Ltd. That concern constructed the original Catalagzi power station which was put into operation early in 1949. This plant already supplies power to the Zonguldak coalfields, and a contract, valued at £T10 million, has now been placed with an Italian concern for the erection of the Karabuk to Ankara overhead transmission line to take power to Ankara from Catalagzi, and for the electrification of the Zonguldak to Ankara railway line.

Acquisition in Lebanon

The Beirut Electricity Co., which is Franco-Belgian controlled, is to be taken over by the Lebanon Government, the Council of Ministers has decided. The price to be paid for its acquisition is 23½ million lire, it is stated. The Government has seized the company's properties

on the ground that it failed to carry out its contract by not providing the necessary electric power for Beirut.

S.W. ASIA

Co-operative Scheme

An experiment in production of electricity by co-operative efforts, claimed to be the first of its kind in Bombay State, is now being made at Tasgaon, a town in South Satara district, with a population of 14,000. The experiment is being made by the Tasgaon Co-operative Electricity Society, which has already started supplying power to the town. The 382-member Society, which has a working capital of over Rs 2 lakhs, at present owns two generating sets, each having a capacity of 105 kW. The Society plans to distribute about 1,000 kW in Tasgaon taluka for domestic, irrigation and industrial purposes. The Society was founded in 1948 by a few prominent residents of Tasgaon. The State Government later contributed Rs 58,330 as loan (at 4% interest, repayable in 15 yearly instalments).

Andhra's Programme

In presenting his budget to the Andhra State Legislature recently, Mr T. Vishwanathan, the Finance Minister, referred to the schemes now under construction in the State to meet the increasing demand for electricity. He indicated that the power supply system covered over 63,000 sq miles, and was fed by three steam power stations and 14 diesel plants in addition to three bulk supply points from hydro-electric schemes. The total installed capacity of the steam and diesel stations together with the power purchased (5,820 kW) from Mysore and Madras States was 39,100 kW. A total ultimate demand of 46,000 kW in 1955 rising to 101,000 kW in 1967 was anticipated. The Machkund hydro-electric scheme, a joint venture of Andhra and Orissa Governments, was expected to go into operation by the middle of 1955, bringing in hydro power to the extent of 24,000 kW for the State. The Tungabhadra hydro-electric scheme was likely to be commissioned early in 1957 providing power to the extent of 27,000 kW for the benefit of Andhra. The policy of Government was to give the highest priority to rural extensions, he added.

AUSTRALIA

More Contracts for Snowy

For the next stage of Australia's Snowy Mountains hydro-electric scheme, contracts have just been placed. This is the T.I. development involving 14 miles of tunnelling to divert waters of the Eucumbene River to the Tumut River, the construction of a 280 ft high dam, and a three-mile pressure tunnel. For the T.I. power station, the English Electric Co., Ltd. has obtained the contract for the supply of two 110,500 h.p. Francis type water turbines, governors and valves, etc. Value of this contract is put at £A465,000. The two associated 80 MW generators are to be supplied by Asea Electric (Australia) Pty. Ltd., a subsidiary of the Swedish concern. The contract for the civil construction work has been placed with the Kaiser-Walsh-Perini-Raymond group, a confederation of American companies. Total cost of the contracts is estimated at £A25 million. In announcing this, the Minister for Natural Development, Senator Spooner, said that plans and specifications for the work had been prepared by the U.S. Bureau of Reclamation, and this had meant a saving of at least 12 months in preparations for the job.

Future Development

In his recent review of hydro-electric activities in Tasmania, Mr Cosgrove, the Premier, said three machines were in operation at Tungatinah and a fourth would be added this winter. Machines and plant for the Wayatinah power development had been ordered and work was up to schedule at present. At the same time work was being undertaken on the Wayatinah "A" station, and the water which originally passed through Tarraleah and Tungatinah would pass through both those stations. Eventually it was expected that a large power station would be built a little lower down, and this station alone would generate another 200,000 h.p. Parliamentary approval had not been sought for the construction of this new station, but when current investigations had been concluded a report would be submitted to Parliament for its consideration.

NEW ZEALAND

Network Expansion

As a further step towards providing electricity along the East coast of North Island, New Zealand, the Poverty Bay Electric Power Board has agreed to raise £50,000, as the first portion of a loan already approved, towards the cost of the distribution network. The Board also decided to raise a loan of £35,000 for work in the inner area, embracing Gisborne borough, Cook County and Waikohu County.

Completion of Maraetai

The fifth and final 36 MW generator is expected to be put into operation at the Maraetai power station, New Zealand, at Easter, to bring the station to its planned installed capacity of 180 MW. The generators are of Canadian manufacture and Francis turbines were made in the U.S.A. (A full description of the station was given in our 11 June, 1953, issue.) A few miles upstream, work continues unabated on the 90,000 kVA Whakamaru power station, the next in the chain of ten stations of the State Hydro-Electric Department which will utilise the Waikato River.

The Richard L. Hearn steam generating station of the Hydro-Electric Power Commission of Ontario, has been shut down until a complete investigation has been made, Mr R. H. Saunders, Chairman of the Commission, has announced. This followed the second explosion at the Toronto station ten days ago, to which we referred last week. Our accompanying photograph shows Mr Saunders inspecting the damaged hydrogen-cooled generator after the first explosion when No. 1 generator was wrecked. The cause of the explosion will not be known until the manufacturer's representatives have made a full investigation. It was stated that it was possible that an air-hydrogen mixture accumulated in the interior of the generator. The explosion ripped out both ends of the set, bursting the oil lines feeding the bearings and causing the lubricant to catch fire. The entire casing of the generator was lifted four inches off its bolts, we understand. After the second explosion, on Monday of last week, Mr Saunders said No. 2 generator was ruined. The set was put out of commission by the first explosion but was back in operation next day, as was No. 4 generator at the east end of the building. No. 3 set was under conversion from 25 cycle to 60 cycle operation at the time. Representatives of C. A. Parsons and Co., who flew from England last week, were in the station when the No. 2 set was involved. The Commission has made temporary arrangements with Detroit Edison to purchase about 80 MW of power during the present difficulties

Personalities

IN THE INDUSTRY

Thorn Electrical Industries Ltd. announce that **Mr Richard Stevens,** B.SC., M.S.I.A., has joined their Atlas Lighting Division and will be responsible for street lighting development. Mr Stevens was recently with Metropolitan-Vickers Electrical Co., Ltd., and previously with Siemens Electric Lamp and Supplies Ltd.

The appointment of new members of the State Electricity Commission of Western Australia has now been approved. The chairman is **Mr A. J. Reid,** the State's Under-Treasurer. The general manager and chief engineer of the Commission, **Mr F. C. Edmondson,** and the Director of Industrial Development, **Mr D. O. Temby,** will remain on the technical side; and **Mr J. W. Young,** the Director of Works, has been appointed to replace the former chairman, **Mr R. J. Dumas,** who resigned some weeks ago (as we reported). **Mr J. Lowe** remains as country consumers' representative, and **Mr A. Richter** as employees' representative. A new appointment is that of **Mr G. Severn,** as metropolitan consumers' representative, who replaces **Mr J. F. Ledger.** These appointments are for a period of three years from 31 Mar.

Mr S. Cornthwaite has been appointed Midlands sales manager of Marryat and Scott Ltd., and will operate from their Birmingham office. He has been in the Lift Industry for 25 years.

The Skefko Ball Bearing Co. Ltd. announces that **Mr L. M. Ballam,** hitherto senior representative at the company's London office, has been appointed as manager at Bristol in succession to **Mr E. Y. Caswell,** who, as recently announced, has been transferred to the company's head office staff in the capacity of sales manager.

Mr Eric Davies has resigned from the board of Hoover Ltd.

Mr A. N. Rye has left the board of Telephone and General Trust Ltd.

Deputy manager of the Hastings district of the South Eastern Electricity Board, **Mr R. C. Carter,** M.I.E.E, retired last week after over 43 years service in the Electricity Supply Industry. Educated at Leamington Technical College, Mr Carter gained early experience with the Midland Electric Light and Power Co., and after a period in Canada, became mains engineer with the Bexhill undertaking in 1915. He served as chief assistant there from 1920 to 1939 when he was appointed borough electrical engineer, a position he held till vesting day, after which he was manager of the Board's Bexhill district for about three years.

Mr G. W. Parkin, M.E., A.M.I.E.E., who has been appointed assistant (electric traction and generation), Mechanical and Electrical Engineer's Department, Derby, British Railways (London Midland Region) began his career on the former Mersey Railway at Birkenhead Central as a junior engineer in 1922, After training and holding various posts he became assistant to operating engineer and later engineer's assistant. He was appointed engineering superintendent in 1928 and continued in that position following the take over of the Mersey Railway by the London Midland in 1951 until December, 1953, when he became acting assistant (electric traction and generation) Mechanical and Electrical Engineer's Department, Derby.

At the annual meeting of the Electrical Society of Glasgow, last week, **Mr W. E. Macdonald,** A.M.I.E.E. (The General Electric Co., Ltd.) and **Mr J. S. Denholm** (contractor) were elected president and vice-president respectively.

Chief engineer of the English Electric Co., Ltd., since 1948, **Mr J. T. Moore,** B.SC., A.R.T.C., M.INST.C.E., M.I.MECH.E., M.I.E.E., M.I.MAR.E., F.R.S.A., is relinquishing that position this month to take up a directorship with Ewbank and Partners, the consulting engineers. A Scot, Mr Moore was educated at the High School, Glasgow, and served an apprenticeship with the Fairfield Shipbuilding and Engineering Co. He graduated from Glasgow University and continued studies at the Royal Technical College, Glasgow. He joined British Brown Boveri Ltd. in 1926, and was transferred to Richardsons Westgarth-Brown Boveri Ltd. as assistant general manager in 1934. He became sales manager of the Steam Turbine Division of the English Electric Co., Ltd. in Rugby in 1936, manager of that Division in 1945, and chief engineer of the company in 1948. Mr Moore has made a number of extensive tours abroad.

Baker Platinum Ltd. announce the resignation of **Mr D. James** as managing director, and the appointment of **Mr S. R. Bryant** to that position.

Mr J. H. Thompson, chief electrical engineer with Newcastle upon Tyne City Transport Department for ten years has retired after forty years' service with the department. He has been succeeded by **Mr W. Pollick,** formerly Mr Thompson's assistant.

C. C. Wakefield and Co., Ltd. announce the appointment of **Mr S. E. Holmes,** A.R.I.C., A.F.INST.PET., as manager and **Mr H. M. White,** B.A.(ENG), as assistant manager of their Department for Technical Information. This department forms part of the Technical Services of the Wakefield Group under **Mr G. H. Thornley,** group technical manager.

Babcock and Wilcox Ltd. announce that **Lt.-Col. P. D. Ionides,** D.S.O., M.I.MECH.E., has resigned from the Board after 26 years' service. **Sir Percy Mills,** Bt., K.B.E., and **Mr. W. F. C. Schaap,** the Company's chief engineer, have been appointed to the Board.

Mr F. Dennis Dent, A.M.I.R.E., a director of Ardente Acoustic Laboratories Ltd., has joined the board of Easco Electrical Ltd.

Mr F. J. Lane, O.B.E., M.SC., M.I.E.E., whose appointment as deputy chief engineer (transmission) to the British Electricity Authority, to which we briefly referred last week, has been transmission design engineer to the Authority since the latter's formation. Earlier he was on the staff of the Central Electricity Board from 1931, being in charge of the system development section at vesting day. He

Mr R. Stevens

Mr J. T. Moore

Mr F. J. Lane

had previously gained experience with the British Thomson-Houston Co., Ltd. as protective gear engineer. Mr Lane was chairman of the I.E.E. Measurements Section in 1951-52.

At present station superintendent at Blackburn Meadows power station, Yorkshire Division, B.E.A., **Mr R. B. Pearson,** A.M.I.MECH.E., A.M.I.E.E., M.INST.F., has been appointed deputy station superintendent at Battersea generating station. Prior to taking up his present post last August, Mr Pearson was station superintendent at Barugh, Barnsley and Wakefield power stations for nearly two years, after a short period as shift charge engineer at Blackburn Meadows. Earlier, he had served as maintenance engineer (electrical) at Huddersfield power station, and in a similar capacity at Deptford East.

Director and joint general manager of Bakelite Ltd., **Mr C. C. Last** has been elected vice-chairman of the British Plastics Federation, with which he has been closely associated since its inception. Prior to the foundation of the Federation he was a member of the Council of the British Plastics Moulding Trades Association and he has since been a member of the Council of the Federation for the whole period of its existence. In addition he has been a member of the Executive Committee for many years, chairman of the Publicity Committee for 15 years, and at various times chairman of the Plastics Material Manufacturers' Section.

Maintenance engineer at Eastbourne power station since 1919, **Mr F. Craddock** has received three presentations—a long service certificate and a gold wristlet watch from the South Eastern Electricity Board and a pressure cooker from his colleagues—to mark his recent retirement.

Our accompanying photograph was taken at the dinner held recently by the West of England branch of the Purchasing Officers' Association, in honour of the visit from the Council of the Association. It shows, left to right, **Mr S. F. Steward,** C.B.E., chairman of the South Western Electricity Board, **Mr E. Stanley,** honorary secretary of the branch, who is fuel purchasing officer for the South Western Division of the B.E.A., **Mr H. H. C. Wood,** president of the Association, who is chief purchasing officer for Igranic Electric Co., Ltd., **Mr J. J. Pritchard,** chairman of the branch, who is chief buyer for the Aircraft Division of the Bristol Aeroplane Co., Ltd., and the Lord Mayor of Bristol, **Alderman Kenneth Brown.**

Mr R. B. Pearson

Mr C. C. Last

Mr H. F. Farmer

On his retirement recently, following 47 years' service with the Electric Construction Co., Ltd., **Mr W. J. Stay,** chief engineer, was presented with a portable radio set and a gold wristlet watch from his friends and colleagues. Our accompanying photograph shows **Mr J. C. Milne,** M.I.E.E., M.AMER.I.E.E., assistant general manager, making the presentation. Mr Stay was later entertained to dinner by members of the Machine Design Department of which he was chief, and at this his colleagues presented him with gold cuff-links.

Mr W. J. Stay, left, receives the gifts

Closely associated with the design and production of electrical control gear for many years, **Mr H. F. Farmer** retired from the British Thomson-Houston Co., Ltd. last week. He joined that company in July, 1906, after completing a course in electrical engineering at Hartley College (now Southampton University), and for several years was engaged on electrical testing, eventually being placed in charge of all heavy plant testing. In January, 1913, he joined what was then known as the Rheostat and Controller Engineering Department, as a junior engineer under Mr H. C. Hastings, to whom he became chief assistant in July, 1919. He was engaged on control gear design until January, 1930, when he was appointed superintendent of the firm's control gear factory, a position he held until the end of 1951, when he asked to be relieved of that responsibility, but remained with B.T.H. as a consultant on matters concerning control gear.

Councillor J. R. W. Rae, district commercial engineer at Durham with the North Eastern Electricity Board, has been elected an alderman on Durham City Council.

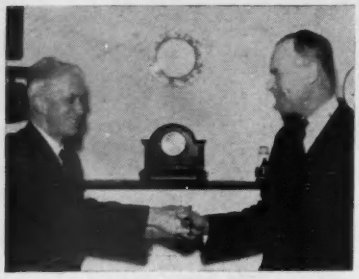
We hear that **Mr H. L. Wickes,** A.M.I.E.E., has resigned his position as sales specialist (motors) with the Brush Electrical Engineering Co., Ltd., which he only took up in February last, and has joined B.K.B. Electric Motors Ltd. as sales manager. Prior to joining the Brush Co., Mr Wickes had been sales manager to Higgs Motors Ltd., since 1940, having joined that concern in 1928. Earlier he had been with Mawdsley's Ltd. for two years, and with the General Electric Co., Ltd., from 1923 to 1926.

By an unfortunate slip the name of **Mr T. D. Childs,** M.B.E., whose appointment as manager in Glasgow to Siemens Electric Lamps and Supplies Ltd. has been confirmed, was wrongly given in our note last week.

To commemorate his completion of 50 years' continuous service with the British Thomson-Houston Co., Ltd., **Mr Philip H. Goddard** was recently the recipient of a presentation made by **Mr R. G. A. Dimmick,** manager of Industrial Motor Sales. Mr Goddard early served in the Wiring Dept., Power House and Motor Factory, before taking a six-year course in the Test Dept. In 1913 he joined what was then known as the Supply Dept., later becoming power engineer first at Newcastle-upon-Tyne district office and later Cardiff district office. Subsequently he returned to Rugby and joined the

At the West of England branch dinner of the Purchasing Officers' Association

Industrial Motor Sales Dept., specialising in the application of electric drives to waterworks and pumping plants. He has contributed numerous articles on this subject to "B.T.H. Activities" and the technical press. He has also devoted considerable time to public services; he served



Mr F. H. Goddard, left, being congratulated

on the Rugby Borough Council from 1937 to 1950, being chairman of the Corporation's Electricity Committee for many years, and was a member of the executive of the I.M.E.A.

In regard to our report last week of the Electrical Development Sales Conference, we should emphasise that the remark of **Dame Caroline Haslett** concerning her future public appearances, related solely to her chairmanship of E.D.A.—which office she has held for the past year. All will agree that Dame Caroline is too valuable a member of the Electrical Industry to be permitted to relinquish any part of her important functions just yet awhile.

Several new appointments affecting the executive staff of Henry Wiggin and Co., Ltd. are announced. They take effect on 1 May. **Mr J. O. Hitchcock** will relinquish his position as assistant managing director of the Wiggin Co. to assume the position of "assistant to the chairman" of the Mond Nickel Co., Ltd. He remains a member of the Wiggin Board. **Mr H. W. G. Hignett,** superintendent of the Mond Nickel Co.'s Development and Research Laboratory, has been appointed to the Wiggin Board and will take charge of technical (metallurgical) control and development in all the Wiggin plants. He is succeeded as Superintendent of the Laboratory by **Mr H. Evans. Mr R. E. Ansell,** manager of the Sales Department, now becomes a member of the Wiggin Board. **Mr O. Lewis Jones** will become general production manager, responsible for production in all the Wiggin plants. He is succeeded as works manager at Birmingham by **Mr C. E. Winfield.** Some changes at the Zenith Works, Glasgow, are also announced. The general manager, **Mr A. B. Graham,** will relinquish this position on 1 July but will continue with the organisation to undertake special duties in connection with production. He will be succeeded as works manager at Zenith by **Mr R. J. P. MacDonald.**

OBITUARY

Mr A. E. Hadley, C.B.E., M.I.E.E., formerly chairman and managing director of the Victoria Falls and Transvaal Power Co., and a director of other concerns, died on 8 April, aged 83. He gained early experience with Ferranti Ltd., and during the 1914-18 war worked as an assistant controller in the Inspection Department of the Ministry of Munitions. Subsequently he was associated with the development of a number of electricity supply undertakings, notably as a director of the City of London Electric Lighting Co., Ltd., and the Northern Rhodesia Power Corporation Ltd., in addition to the Victoria Falls concern.

Mr T. N. Dunn, manager of the Service Department of Bulpitt and Sons Ltd., died on 12 Apr., aged 52. He joined that firm's Electrical Department in 1929.

Mr E. B. Walden, a director of Premier Electric Heaters Ltd., died on 24 Mar., aged 57. He had been associated with the development of that company since 1922, having joined the firm originally as buyer. With amazing energy he worked tremendously hard to foster a rapidly growing business, and later became sales manager. When the company became a member of the A.E.I. group, Mr Walden was appointed a director.

Mr P. W. Turner, A.M.INST.C.E., M.I.E.E., formerly managing director of Surbiton Aircraft Products Ltd., died on 6 Apr., aged 73. Mr Turner gained early training and experience with Mather and Platt Ltd., and after a period with a firm of consulting engineers became manager of the Manchester branch of The Electrical Co. in 1908. The following year he was appointed chief engineer at the London office of the A.E.C. Foreign Department. From 1910 to 1914 he was the Far Eastern representative of that concern, after which he acted for a time as a consulting engineer, before his appointment as representative of the General Electric Co., Ltd., and its affiliated concerns, for Manchuria, Korea and North China. During the last war he worked for a time in Rio de Janeiro before returning to this country.

NEW LITERATURE

High Voltage Laboratory Technique

by J. D. Craggs and J. M. Meek

WITH the ever-increasing requirement for high-voltage research, both in the power industry and in other fields, many manufacturing and research concerns have been establishing high-voltage laboratories. Hitherto, the available information on the techniques which have been developed by workers in high-voltage has been scattered among numerous technical papers and scientific articles. The need for a book collating much of this information has now been met by the publication of this volume. It deals mainly with research laboratory considerations and describes in some detail the circuits and machines available to produce both a.c. and d.c. high voltages. These include, apart from the impulse generators and high voltage transformer systems such devices as electrostatic generators, particularly of the Van de Graaf type and Tesla coils.

The chapters on the measurement of the high voltages produced are particularly important as this presents one of the most difficult problems encountered in high voltage work The last few chapters of the book deal with the use of oscillographs for the recording of impulses and short duration transient phenomena. Published by Butterworth's Scientific Publications. 404 pages, 9¼ in. by 6 in. Price £3. 6s.

Electricity and Magnetism

by E. R. Peck

ONE of the principal difficulties in teaching electricity and magnetism is that a fundamental attack on the subject requires a fairly advanced knowledge of mathematical techniques and physical concepts. Lack of this knowledge makes it difficult for the student to appreciate the underlying significance of the formula used and their derivation and consequently a certain amount of confusion and bewilderment arises. This volume is therefore based on the assumption that the reader has a good background of general physics and the calculus. It is mainly theoretical in content, and covers electrostatics; dielectric theory; electrostatic energy, force and capacitance; the electric current, steady-state magnetism; electromagnetic induction; magnetic properties of matter; transient currents; analysis of a.c. circuits; Maxwell's equations and electromagnetic waves. The most useful function of the book lies in the logical and painstaking treatment of the subject, a vital necessity for clear thinking and rational understanding. Published by McGraw-Hill, 476 pages, 9 in. by 6 in. Price £3.

Wireless and Electrical Trader Year Book

THIS very useful reference book has again been brought up to date in the 1954 edition just published. As before, its features include condensed specifications of over 250 current commercial televison sets and 300 radio receivers, with information on valve base connections, etc. As a new feature, the wages agreement for radio and TV service engineers is included. This is followed by a list of trade addresses, proprietary names and a buyers' guide to assist traders in keeping abreast of the constant changes which occur in the industry. Altogether it provides excellent value for money. Published by Trader Publishing Co., Ltd., 296 pages, 8¾ in. by 5½ in., price 10s. 6d.

PROBLEMS AND PRACTICE

In Engineering

Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.

Removing Floorboards

THE development of this tool for removing tongued and grooved floorboards arose through the need to cut between very closely fitting floorboards where the usual methods were unsatisfactory and caused considerable damage to the floor. It appeared that the only way to do this satisfactorily was to force a long thin blade down between the boards in order to split the tongue away. An experiment with an old tenon saw with some means of forcing it down seemed to provide the answer and a temporary tool on these lines was made.

The handle was first removed and the teeth cut away leaving the saw looking pretty useless. However the back was left on the blade. The next thing required was something in which to place one's foot to give the necessary push, a piece of 1 in. conduit about 3 in. long welded

Here, the special tool for removing tongued and grooved floor boarding is shown in action (photo: "Southern Electricity").

at right angles to the blade provided this. An 18 in. length of 1 in. conduit welded at the other end made a suitable handle.

After a little use a few modifications were found to be required. First, the back of the saw was not rigid enough and the blade pulled out; this was replaced by two strips of 1 in. by ¼ in. strap iron with the blade riveted between them. The short piece of conduit was welded on as before, but at the other end the 18 in. length was replaced with a 1 in. socket allowing the handle to be screwed in, making the tool a little more portable.

The best method of use has been found that, standing over the join facing the direction of travel, the blade is pressed between the boards with the foot and then the handle pushed forward. This will cause the blade to enter its whole length. The operation is then repeated for the required distance.

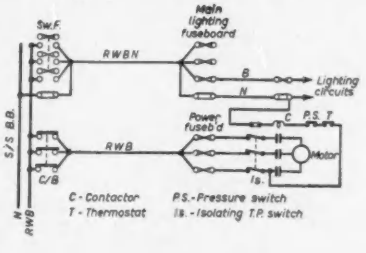
On the more usual type of flooring where the boards have shrunk, its use is more rapid and it is possible to move along with a continuous rocking motion. This tool seems to thrive on the usual grit found between the boards which soon blunt a saw. When a knot is encountered a tap with a hammer on the back of the blade will overcome this. In conclusion, I would like to thank the Southern Electricity Board for permitting me to describe this tool.—*S. F. Hennell.*

Haphazard Neutral Connection

THE following account reveals the danger that may lie in an incorrect neutral connection, a damage which may be obscure to an inexperienced wireman and one seldom revealed until a possibly severe shock is experienced by some unfortunate electrician at a later date.

The incoming cable was being disconnected from a t.p.n. fuseboard when the electrician received quite a nasty shock whilst separating the cable lug from the neutral bar. The cable fed from a switch-fuse in the substation had been made dead by the opening and locking out of this switch, and all the fuseboard phase connections had been uncoupled without trouble. A voltmeter showed 220 V from the fuseboard neutral bar to the disconnected cable neutral, which was most disconcerting to say the least. The substation switch-fuse opened all phases but the neutral link was left intact so this was also opened, the fuseboard neutral to cable now showing no volts.

Circuit for lighting and refrigerator supplies showing how the common connection arose

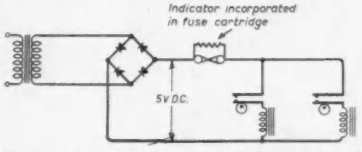


After a rather protracted search through all circuits fed from the fuseboard the cause was located in the canteen, the lighting of which was taken from this board. All the kitchen appliances were three-phase and supplied from a 415 V t.p. fuseboard, including the refrigerator motor, but the control of this, operated by pressure switch and thermostat, was at 230 V, and to obtain this a neutral wire had been taken from a near-by lighting board and incorporated into the t.p. power supply, making it t.p.n. The refrigerator had been running until the neutral connection was broken by the electrician in the main lighting fuseboard, thus opening the contactor coil circuit as shown in the sketch.

To remedy this faulty installation a 230 V single-phase supply was taken from the local lighting board to a d.p. switch fitted alongside the refrigerator t.p. switch, the handles of which were then mechanically linked so that the operation of each took place simultaneously, cutting off all power to the refrigerator. Both switches were marked externally with circuit identification labels.—*T. H. Snelson.*

Poor Fusing

A REPORT was received that, on a machine tool, two electro-magnets would not operate together, as they should but would operate individually. The supply was from a 5 V rectified d.c. circuit.



High resistance in the indicator fuse prevented the two solenoids from operating

Usual testing routine indicated a resistance in the d.c. line, causing excessive voltage drop, which was localised on a 4 amp h.r.c. fuse cartridge. The indicator, which was incorporated in the fuse cartridge, had not operated, but the measured fuse resistance was 5 ohms.

Further investigation revealed that the fuse had been blown by fitters working on the machine, but the circuit voltage had been insufficient to fuse the indicator circuit of the fuse cartridge. This resistance was not sufficient to prevent one electro-magnet from operating.

As the wrong type of fuse was in use, this was replaced by a low voltage type, which cleared the fault and prevented a repetition.—*P. N. Yeo.*

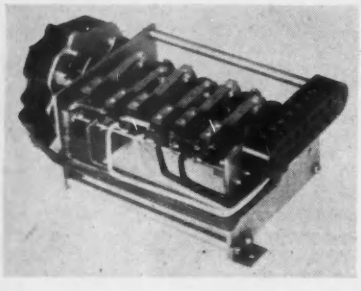
Equipment for Industry

Multi-Circuit Sequence Timers

PRIMARILY designed for controlling a continuously repeating cycle of operations, the multi-circuit sequence timer type CST recently developed by ELECTRICAL REMOTE CONTROL LTD., Elremco Works, East Industrial Estate, Harlow New Town, Essex, has possible applications ranging from the flashing and spelling of neon lighting signs to electric motor reversing. Normally, these timers repeat a specified sequence of operations continuously as long as its synchronous motor is connected to the supply, but if a relay be added to it, the timer may then be actuated from an internal limit switch or push button, stopping after every complete cycle.

As already stated the power source is a synchronous motor, geared to a shaft with cams which operate banks of contacts in a sequence and at intervals specified by the user. In its simplest form, the CST timer has but one cam and one contact pair but extended models are available having up to 120 cams controlling 240 contact pairs. By choice of a suitable synchronous motor and gearing, complete cycles may be made to cover virtually any period of time between one second and one week. Timing intervals between closing or opening of consecutive contacts are determined solely on the user's specification; the usual accuracy of setting stated to be 0·3% although an accuracy of 0·01% is claimed to be attainable.

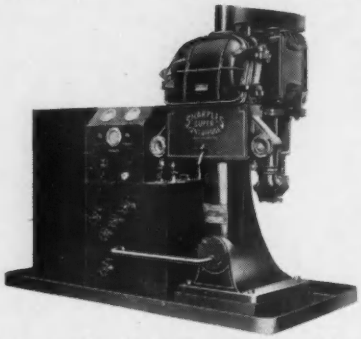
The "Elremco" multi-circuit sequence timer type CST arranged for six contact pairs



Although manufactured as standard for operation from 230 volts, or 415 volts both at 50 c/s, single phase, timers can be supplied for any a.c. supply voltage between 6 and 550 volts. Where an alternating supply is not available, type CST/DC timers are available which differ from the other type only in that a d.c. motor is used. These can be supplied for supplies up to 250 volts d.c. Normally the switching capacity is 5 amps at 230 volts.

Purifier for Turbine Lubricating Oil

FOR power stations where it is required to purify turbine lubricating oil with equipment designed specifically for that purpose, two new ranges of installations are now available, both incorporating an indirect type oil heater. Manufactured by SHARPLES CENTRIFUGES LTD., Tower Hse, Woodchester, Stroud, Glos., both types are based on their efficient tubular bowl super-centrifuge,



The new Sharples Series 'D' turbine lubricating oil purifier, which is the showpiece model

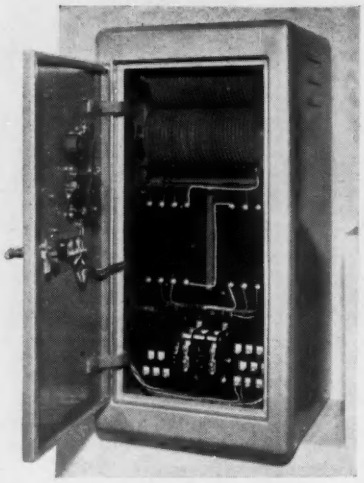
general layout being designed to conform to modern power station practice in appearance and ease of maintenance.

Of the two models, the series "S" purifier is the standard model designed to meet the requirements of economy in first cost. Although heater controls and motor starter are panel mounted, pressure gauge, oil thermometer and valves are mounted directly on the pipe work. In the other model, however, emphasis has been given to appearance, and this series "D" purifier may be regarded as a showpiece.

Incorporated in the purifier is either a feed pump or discharge pump, determined by whether feed or discharge is effected under gravity. Where required both pumps can be fitted. Of the gear type, the pumps are driven directly off the centrifuge motor through a speed reducer on the centrifuge frame. Pipe connections may be varied to suit operating requirements, provision also being made to bypass the oil heater should it be found necessary to remove the heater without stopping the centrifuge itself.

Variable Speed Motor Drives

MANY drives in modern industrial processes require a variable speed, either automatically or manually controlled and where a.c. supplies only are available difficulties in obtaining a wide



Control cubicle of the M.T.E. "Vari-drive" speed control unit as it appeared at the A.S.E.E. Exhibition

speed range are often encountered. After two years of research and development, M. T. E. CONTROL GEAR LTD., Leigh-on-Sea, Essex, are now producing commercially their "Vari-drive" unit which gives infinitely variable speeds over a 15 to one range. At present it is available in sizes from ¼ to 3 h.p. but they anticipate to be able to extend this range upwards in the future.

Employing a d.c. motor which differs from standard machines only in that it is designed for operation from a full wave rectified supply, the drive control is effected from a cubicle which houses all associated equipment. Not being an electronic device, the unit does not suffer from an initial heating-up delay but is ready for immediate service at all times. The control component contains a specially designed electro-magnetic system based on transductor techniques, the output from which is fed to metal rectifiers to give vernier speed control of the driving motor.

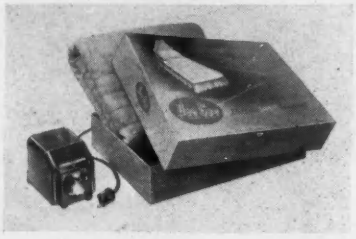
L.D.C.'s Four-inch Magnetic Brake

EXTENDING their range of 6 in. and 8 in. electro-magnetic brakes, LANCASHIRE DYNAMO AND CRYPTO LTD., Trafford Park, Manchester, have introduced a 4 in. brake designed for integral mounting on small L.D.C. motors up to 1,500 r.p.m., 2 h.p. according to the type of duty. It has a maximum dynamic frictional torque of 7 lb/ft.

In construction, the brake comprises a 4 in. diameter steel disc keyed to the motor shaft extension, with asbestos fabric friction surfaces on each face. When the solenoid is unenergised, a pivoted brake lever applies pressure to one disc face through a steel ring, the further disc face coming in contact with a mating surface on the fixed back plate. On closing the circuit, the solenoid pulls the arm away releasing the pressure on the disc, a coiled spring on the arm ensuring its return to the braking position when released.

Dee Gee Produce 12 V Blanket

LOW voltage heating elements for safety are incorporated in a new electric blanket produced by DAVID GRIFFIN LTD., Wimborne Rd, Poole, Dorset. For mains use the blanket is interconnected with the transformer control unit, which has three heat switch control, whilst an extra feature of interest is that, provided with a suitable extension from the electrical system, the blanket can be used in a motor car providing that the system voltage does not exceed 12 V.



The blanket with mains transformer control unit

The blanket is made from pure wool velour blanket cloth, guaranteed moth proof and fast dyed in pastel pink, blue, or biscuit. There are two sizes, the large 60 in. x 36 in. or a small 36 in. x 19 in. size suitable for the baby's cot or a child's bed (this is not available in biscuit). It can be washed in the ordinary way although it is not recommended that it be "screw-wrung out." Price of the large model is £9. 18s. (inc. control unit) and the small baby model £6. 12s. A flexible cable and plug for connection to the car circuit is priced 3s.

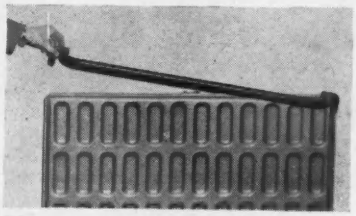
Dewlite Two Colour Lamps

DEVELOPMENT by a Scottish firm, DALZELL ELECTRIC WELDING CO., LTD., Dewco Works, Mossend, Belshill, is a range of twin filament two colour lamps made in a variety of sizes including motor vehicle lamps and normal general service lamps.

Each of the filaments is separately switched so that they can burn separately or together and need not be of equal wattage. An opaque screen separates the two filaments.

Their use in motor vehicles is said to be wide and suggested uses are for rendering spotlamps into combined spot or foglamps using the clear-amber lamp; for adapting headlamps to show a white beam changing to amber when dipped; and for making a combined stop and reversing light in one housing using the white/red lamp. Their use is suggested in flashing trafficator indicators using a combination of green and amber at rear, or at the front a white/amber in the side lights for giving either a flashing amber by day, or by night a steady white with flashing amber.

The use of these lamps in industry, in the home for televiewing, nursery lights, in hospital wards and in advertising signs can easily be appreciated.



The new single sided towel rail produced by DIMPLEX LTD., Totton, nr. Southampton, Hants, for their panel type electric radiators. It is detachable and is for the ½, ¾ and 1 kW models with prices ranging from £1. 0s. 9d. to £1. 6s. 6d. including tax

Plastic Conduit and Fittings

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has perfected a conduit tube made in P.V.C. which can be used for electrical installations, where severe corrosive conditions exist. It is resistant to the majority of acids, unaffected by moisture or damp, oil or grease, and may be buried in the ground, lime, mortar or cement. Lighter than steel or aluminium, it is non-inflammable, does not split or fracture, and remains rigid in temperatures up to 140° F.

Manipulated and handled like steel conduit this tubing means that the wireman does not have to learn a new technique. Bends and sets can be made cold in the normal way, no heating being required. Threads can be cut with ordinary screwing tackle. So far as limits and size are concerned the tubing conforms to British Standard 31. When it is supported by saddles these should be placed at closer intervals than for steel.

The standard G.E.C. range of malleable iron or pressed steel conduit fittings can be used with this tube but first need treating in one of two ways. They can be coated with P.V.C. but fittings so finished, however, cannot be delivered from stock but have to be specially prepared at an extra cost.

The alternative, which involves a lower increase in cost, is to paint the fittings with a special coating of chlorinated rubber which is highly resistant to alkalis and unaffected by acids, sea or fresh water, alcohol, animal, vegetable or mineral oils and petrol. It is also stable with such oxidising agents as nitric acid. Delivery of fittings finished to this specification can be made in two or three weeks. The chlorinated rubber paint can be supplied separately in quart, ¼ gallon and 1 gallon cans, together with suitable thinners when required.

Trade Publications

SWITCHGEAR BULLETINS.—In order to familiarise prospective users with the current ranges of domestic and light industrial switchgear, the GENERAL ELECTRIC CO., LTD., Magnet Hse, Kingsway, W.C.2, are now issuing a series of switchgear Bulletins. So far, three are available dealing with "H.W." switchfuses, "M.W." fused switches and "N.W." switchboard components respectively.

"HIDUMINIUM 100"—Technical data and properties of this new aluminium base material for use at temperatures up to 500° C. are now published in a booklet obtainable from HIGH DUTY ALLOYS LTD., Slough, Bucks.

ELECTRICAL INSULATION MATERIAL—A wide range of "Delanco" products in various insulating materials is described in a catalogue recently published by the ANGLO-AMERICAN VULCANIZED FIBRE CO., LTD., Cayton Works, Bath St, E.C.1.

For the Electrical Trade

M.R. Steam/Dry Iron

MARKETED at the low price of £2. 19s. 6d., the new Steam/Dry heat controlled iron developed by MORPHY RICHARDS LTD., 6 Conduit St, W.1, is unusual in that it employs the "boiler" type of steam generation rather than the "drip" method. It contains a small "kettle" boiler which is heated by the iron element. When the water boils steam steadily issues through the ducts in the soleplate until it boils away (usually in about 25 minutes). The makers say that by varying the temperature you can also vary the rate at which the steam emerges so that when a hotter setting is made for fabrics like linens and cottons more steam is generated.

Automatic pilot light and reversible flex-entry are two M.R. features incorporated whilst a graduated measure for filling with tap water and a bottle of tank descaling fluid are provided.

The filler hole is in the front of the handle

NEWS OF THE WEEK

Selective Tendering Recommended

Architects', Surveyors' and Builders' Committee Reports

INDISCRIMINATE tendering leads to bad building and throws upon the building industry an unnecessary burden of time, effort and expense in the preparation of tenders. This conclusion is stated in the Report of a Joint Committee on tendering procedure which was set up by the Royal Institute of British Architects, the Royal Institution of Chartered Surveyors, and the National Federation of Building Trades Employers. This and other conclusions are likely to affect electrical contractors in the future. It is recommended that for most authorities the method of advertising each contract and then calling for firms to apply for permission to tender is desirable. An alternative method is to maintain lists of firms in different areas suitable and competent to carry out certain types of work. The Committee does not recommend any payment in the form of a fee by way of even part reimbursement of the cost of preparing tenders.

Planning in advance is strongly recommended, and it is regarded as equally important that specialist services designed by consultants should be subject to the same measure of preplanning as the main building. In this respect, adequate drawings properly displayed should be available at the tender stage. Numbers invited to tender should vary from four firms for contracts below £500 upwards, with six in the range £500 to £10,000.

The Committee supports the practice of architects nominating specialist subcontractors, but it is considered undesirable for clients to make direct contact with specialists. It is of first importance, however, that the general contractor should, under the architect, be in full control of the whole of the executive work on site. The employment of consultants in suitable cases is recommended.

I.o.F. President Reviews Power Sources

THAT coal is likely to continue Britain's main source of heat and power for many generations to come is the conclusion of Dr W. Idris Jones (Director-General of Research, N.C.B.), who is President of the Institute of Fuel. In his presidential address, "Energy for Britain—the Decades Ahead," which was delivered in London on Thursday last, he considers alternative fuels and sources of power. He suggests efficiencies of 32% for thermo-electric power generation by the year 2000 A.D., 70% for industrial steam generation, 10 to 15% for railway traction, and 50 to 60% for domestic heating. He gives comparable present-day values as 22%; 50%; 7%; and 30% respectively.

SHARE IN DOLLAR ORDER

FOLLOWING our report a short time ago that British Insulated Callender's Cables Ltd. had secured a contract from British Columbia Electric Co. for the supply and installation of submarine electric cable, we learn that construction of some of the special plant for the manufacture of the cable has been entrusted to B. and F. Carter and Co., Ltd., of Bolton. The Glover 138,000 V gas-filled type cable is to be laid across the Georgia Strait from the Canadian mainland to Vancouver Island. The order is valued at over $3 million. B. and F. Carter and Co., Ltd. are noted for their special equipment for making electric cable.

Midland Firm's plan to export Washing Machines to Western Germany

THE Darlaston company of Wilkins and Mitchell Ltd. is to take advantage of the recent liberalisation of German trade policy to export washing machines to Western Germany. We understand that the company is hoping to sell its full range of five appliances at prices which will compete with locally made products, even allowing for a 12% duty and 6% purchase tax. This is in fact less than the duty charged in many other overseas markets. Assembled machines for the Australian market carry a duty of some 25%. Preliminary arrangements are now in hand and discussions taking place as to the best way of tackling the market, and the German housewife's different attitude towards the washing machine.

Western Germany has now become a creditor nation in the European Payments Union, and as such is obliged to free as much trade as possible from import restrictions. Hence her new trade policy.

Electricians get another ½d

ELECTRICIANS engaged in the Electrical Contracting Industry have been awarded a further ½d. an hour, backdated to 15 Mar.—the date of the increase of 2d. an hour which the National Federated Electrical Association offered and the Electrical Trades Union accepted. When the latter agreement was reached (see 18 Mar. issue), it was agreed that the E.T.U. should continue its claim for a substantial increase in pay. After discussions the matter was referred to the Industrial Disputes Tribunal for arbitration. The result is this further award of ½d. for journeymen electricians with proportionate increases for other grades. The new hourly rates of pay for electricians are: Grade "A" 4s. 2½d.; Mersey district 3s. 10½d., and Grade "B" 3s. 9½d.

Committee to Solve Shortage of Teachers

A COMMITTEE has been set up by the Federation of British Industries to study the problem of the current shortage of science teachers. Its aim is not only to improve the supply of science teachers during the anticipated difficult years of 1955 to 1960, but also to seek a permanent solution to the difficulty. It will be recalled that this matter was the subject of a special conference of educationalists and industrialists organised by the F.B.I. last January and a resolution was passed then that such a committee should be formed.

The body will act under the chairmanship of Dr Percy Dunsheath—all members serving in a personal capacity. There will be five members representing schools; three representing the Universities; one attending on behalf of technical colleges; seven including Mr G. S. C. Lucas of the British Thomson-Houston Co., Ltd., representing industry; and three, including Dr B. K. Blount, of the D.S.I.R., representing government and nationalised industries.

U.K. Plant for Yugoslavia

A NEW cable impregnation control station destined for a recently built cable factory in Yugoslavia has been completed by the Addison Electric Co., Ltd. The equipment was designed with the co-operation of the General Engineering Co. (Radcliffe) Ltd., who are supplying the impregnating plant in the same contract. The plant consists of 10 electronic Addison impregnation recorders and is claimed to be one of the most up-to-date control stations of its type.

52,000 Consumers in North East pay Bills Fortnightly

THE SYSTEM of collecting payments for electricity, at short and regular intervals, has recently been extended by the N.E. Electricity Board. This method of collection was operated by some Municipal Undertakings and taken over by the Board in 1948, but it has now been expanded to local authority estates, lying mainly in the Wear sub-area. The domestic consumer can elect to pay his bills in this way provided it is practicable. Payment is assessed on the number of rooms and suitable weekly, fortnightly or 4-weekly (usually fortnightly) amounts paid. A dwelling with four rooms and an estimated supply of 240 units p.a., is assessed at 2s. 10d. a fortnight—an additional charge is made to cover extra cost involved in making the special collection, and excess units consumed above 240 units is chargeable at ¼d. per unit.

63 years old Mr Wilfred Wilson of Blackburn, totally blinded at Ypres in 1916 visits the electricity showrooms every Wednesday to collect his "savings" stamps. On a recent visit (pictured here) he was presented with copies of the Braille cookery books by demonstrator Mrs C. M. Roper

The north of England appears to abound with these schemes for easy-payment of electricity bills. On the other side of the Pennines there is the 2s. 6d. savings stamps scheme, which, as reported last week, sell at the rate of about 25,000 a week. The Fortnightly Collection Scheme in the north-east involves some 52,000 consumers.

We understand also that talks are taking place at present between the N.E. Electricity Board and Jarrow town council concerning the installation of electric cookers in council houses being built.

ELECTRICITY IS ANSWER TO CATERERS' PROBLEMS

WITH the holiday season so nearly upon us once again, the N. Western Electricity Board has held a small exhibition intended for proprietors of seaside hotels, boarding-house keepers and caterers. Most appropriately it took place at Blackpool, and on view was a large range of electrical equipment available at the present time. A remarkable tribute was paid to the industry at the opening of this Catering Equipment Exhibition, by the well-known chef, M. Jean Conil. He told caterers that electricity was the answer to kitchen problems.

The exhibition had two model kitchens as its main set pieces. One contained equipment suitable for a boarding house taking between 50 and 75 guests, and the other for an hotel catering for between 250 and 300 visitors. It was officially opened by Mrs H. Charlesworth, president of the Federation of Boarding House Associations.

General view of the Catering Equipment Exhibition staged by the N. Western Electricity Board at Blackpool earlier this month

British Pavilion at Sweden's Trade Fair

FOR THE third successive year, the U.K. is to have her own pavilion at the St. Eriks Fair, which is to be held from 28 Aug. to 12 Sept. in Stockholm. This is probably the largest and most important trade exhibition held in Scandinavia; its growth over the years has been quite phenomenal, and it is known that much business has resulted from previous participation. It is customary to allot one of the days for each country which has a national pavilion to celebrate a Nation Day. Britain's Day this year will be 7 Sept. Although Sweden is probably the U.K.'s largest market in Europe, we note that our chief competitor there, Western Germany, had the biggest pavilion in 1953, with 109 exhibitors. Britain's pavilion last year housed 64 exhibitors.

B.E.P.C. Details

AT a press conference which surveyed plans for the British Electrical Power Convention, to be held at Eastbourne from 14 to 19 June, it was announced that the paper which Sir George Nelson has written for the Convention, entitled "Electrical Engineering in World Trade," would be read at Eastbourne by Mr H. G. Nelson, as Sir George would be out of the country.

OFFICIAL PUBLICATIONS

BRITISH STANDARDS. Amendment Slips: B.S. 1113: 1951: Water Tube Boilers and their Integral Superheaters, Amendment No. 2 (ref.: PD1813); B.S. 1975: 1953: Primary Cells and Batteries for Intrinsically Safe Bell Signalling Circuits in Coal Mines, Amendment No. 1 (ref.: PD1819).

B.S. 1991, Part 1; 1954: Letter Symbols, Signs and Abbreviations, Part 1. General.

Electric Motor-Operated Appliances for Domestic and similar purposes. C.E.E. Publication, 1s.

TENDERING PROCEDURE. Report of Joint Committee. Available from R.I.B.A., Royal Institution of Chartered Surveyors or National Federation of Building Trades Employers. Price 9d. (see page 560).

MINES. Report of H.M. Inspectors for 1952, Northern Division.

E.A.W. Celebrations

AMONG recent E.A.W. activities have been celebrations in Plymouth to mark the branch's silver jubilee, and the formation of two new branches. The Plymouth branch is the 14th to reach its 25th birthday and the occasion was marked by a luncheon which was attended by Lady Carew Pole, chairman of the S.W. Consultative Council, and the Lord Mayor, Ald. Sir Clifford Tozer, and Lady Tozer.

Inaugural meeting of the Portsmouth branch took place on 30 Mar. Clr. Mrs H. M. Kerr is chairman and Miss Wardale, hon. secretary. Another branch formed was at Caernarvon, where the chairman is Mrs W. T. Williams and hon. secretary Mrs Bennett Williams. There are now 138 E.A.W. branches.

We hear also that a new branch of the Association is to be formed at Loughborough shortly. A preliminary meeting is being held this month.

Travelling Exhibition

THE Caroline Haslett Trust announces that applications for the award of a Travelling Exhibition should be returned to 35 Grosvenor Pl, S.W.1, before 24 May. Candidates will be interviewed on 11 June. The country selected for this year's exhibition will be Finland.

CONCERN OVER MERGER OF SCOTTISH BOARDS

COMPLAINTS that they had not been consulted, and concern over their future status, were expressed during discussion on the Electricity Reorganisation (Scotland) Bill, at the recent meeting of the S.W. Scotland Electricity Consultative Council in Glasgow. The Bill provides for the merging of the two southern boards into one, resulting in a single consultative council. One member said there was ample scope for both the existing councils to continue to operate in their respective spheres, in fact, he added, the new council would probably meet in Edinburgh and get farther away from the consumer than they were at present.

Another member pointed out, however, that two councils might tend to confuse a single board. He expressed alarm, however, on behalf of consumers in S.W. Scotland because, he said, they would probably be the losers in any equalisation of charges. The Council agreed to set up a sub-committee to consider the Bill, with a view to submitting recommendations to Parliament while it was still in the committee stages.

S.E. SCOTLAND BOARD SAVES RURAL SCHOOLS

THE appeal of Berwickshire's Education Committee and S.E. Scotland's Electricity Consultative Council for priority in supplying rural schools with electricity has been heard and acted upon. At the Consultative Council's meeting in Edinburgh last week, members were told that the Board hoped to supply six schools with electricity within the next year. As reported in our 11 Mar. issue the education committee became alarmed because teachers would not take up appointments at schools lacking modern amenities, and some resigned for the same reason, with the result that certain schools in outlying districts might have to be closed. The committee appealed to the Consultative Council who added their support.

As regards the two schools in imminent danger of closing down, the Board has stated that quotations for the provision of supplies were being sent immediately to the county council, and work would be put in hand as soon as possible on acceptance. Work on the others would be carried out during 1954-55 in conjunction with rural electrification work already planned. The Board added they could make no promises as regards a number of other similarly positioned small schools in the county.

The First Half-Century

The Leeds section of the I.E.E. have held a sort of local parliamentary debate on "Power Schemes, Projected and in Operation, Mr W. B. Woodhouse in the affirmative, Mr W. Emmott in the negative." It is not stated what the one affirms or the other denies. But whatever the original intention, the debate became one between the upholders and the opponents of municipal trading. Mr. Woodhouse supports power companies because large stations and large engines mean lower costs, and because improvement in load-factor may be expected to result from a supply over a large area and hence less spare plant is wanted. Also the increased cost of transmission with distance can be met by increase of pressure. Mr. Emmott proved an out-and-out advocate of municipal supply. Transmission costs would wipe out any gain in the coal bill by generating on a large scale. Small and inefficient engines, and obsolete machinery were not necessarily connected with municipal management, and it was necessary to guard against the setting up of monstrous monopolies.—*From our issue of 14 Apr., 1904.*

New Laboratories for Welding Research

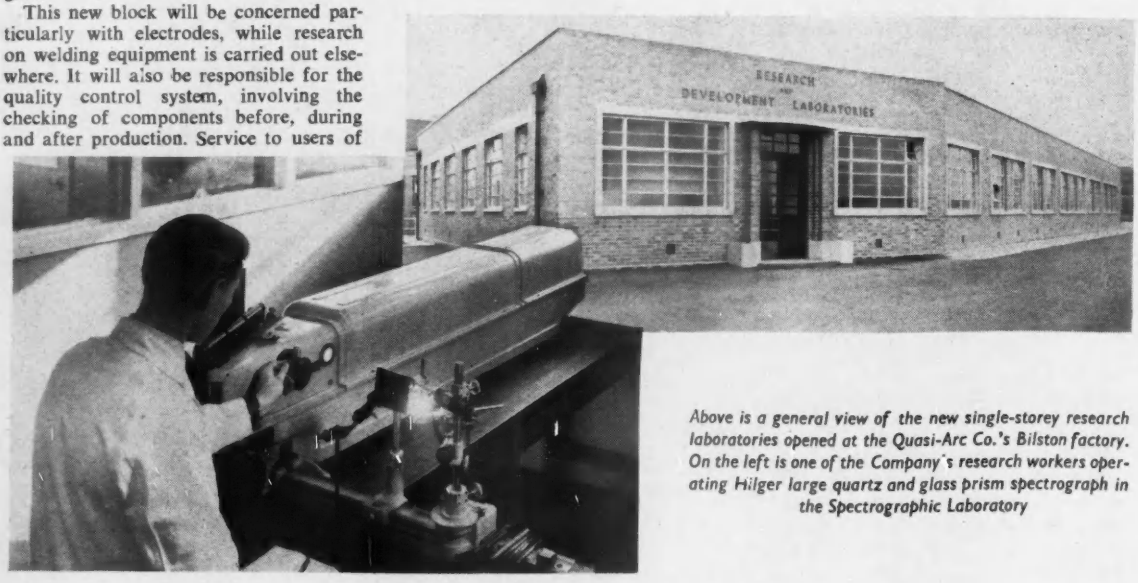
NEW and up-to-date laboratories were officially opened recently at the Bilston factory of The Quasi-Arc Co., Ltd. The ceremony was performed by Mr J. S. Hutchison, chairman of the British Oxygen Group of Companies. The newly erected block is a single storey building covering some 11,000 sq ft and is so designed to allow the addition of a second storey as and when required. Already this company is providing a world-wide service covering nearly every known welding application and the new building should do much to provide research and development facilities for further progress.

This new block will be concerned particularly with electrodes, while research on welding equipment is carried out elsewhere. It will also be responsible for the quality control system, involving the checking of components before, during and after production. Service to users of welding will also form an important part of the work of the new Research and Development Department in investigating problems and advising on materials and techniques.

The laboratories will comprise eight main sections, namely electrode development, chemical analysis, spectrographic analysis, mechanical testing, physical testing, metallography and petrology, X-ray diffraction and industrial radiography. A full description of each section, as well as a background story of Quasi-Arc is included in a brochure published to commemorate the opening.

No Technical College Yet

A PROPOSAL that a technical college should be established in Caithness to give the country's youth an opportunity to play their part in developments which will follow at the experimental atomic energy station at Dounreay, was made at Caithness Works and Finance Committee meeting. It was turned down on the grounds that the estimates were already too high but the matter is to be raised again.



Above is a general view of the new single-storey research laboratories opened at the Quasi-Arc Co.'s Bilston factory. On the left is one of the Company's research workers operating Hilger large quartz and glass prism spectrograph in the Spectrographic Laboratory

Lightweight Gas Turbine Driven Fire Pump

LIGHTWEIGHT, small bulk, easy and quick starting, fast priming and dependability are all essential qualities which the fire fighter demands of his equipment. Constantly striving after the ideal, Sigmund Pumps Ltd. have now produced their Rover 1S/60 ultra-lightweight fire pump which represents a big advance towards perfection. This latest model incorporates advances made in gas turbine design and development. As can be seen in our accompanying illustration it consists of a Rover lightweight gas turbine engine and a specially designed Sigmund high speed centrifugal pump, coupled to the power unit. The whole is mounted in a turbine frame complete with fuel tank and instrument panel. It can be used either as a portable unit or as a trailer. The assembly can be run on petrol, paraffin, diesel fuel or any distillate fuel.

Although the pump's primary use will almost certainly be on land, it is also suitable for service afloat. The prototype unit has been successfully tested and initial orders received. Government Departments and the Fire Services have expressed their interest.

Sigmund Pumps' new fire pump, the Rover 1S/60 powered by gas turbine

Inaugural Social

FIRST annual dinner and dance of the newly-formed North Metropolitan branch of E.I.B.A., held recently, was a most successful and encouraging function. A total of £100 was raised for the Association's funds. The function took place at the Waterend Barn, St. Albans, and was attended by some 150 members, their friends and guests. President of E.I.B.A., Sir John Dalton, and Lady Dalton, were present, being entertained by the branch chairman, Mr C. C. Hill, and Mrs Hill. The date for next year's social has already been announced, namely 18 Mar., at the same venue.

Long Service Reunion

NEARLY 400 members and friends of the B.T.H. (Willesden) Long Service Association assembled recently for another annual reunion at Wembley. Thirty new members, having served with the company for at least 25 years, joined the Association this year, and a further 32 members qualified for the certificate marking 30 years' service. Over 170 Willesden employees now hold this certificate. Chief guest at the party, dance and cabaret was Mr H. L. Satchell, director of the company and manager at Rugby.

New London Showroom

ENGINEERS wishing to discuss problems of circuit protection will welcome the opening of a new London Office by Chilton Electric Products Ltd. The office is situated at 19 Old Queen St, S.W.1. and it will be the headquarters of Mr H. W. Swann, who joined the Board of Chilton Electric Products after retiring from the Factory Inspectorate.

Small Service Centres in Every Store?

A NEW idea of independent service centres, to be known as Joan Storey Home Service Centres of 60 New Oxford St, W.C.1, is planned for all big stores in the country. Miss Joan Storey, originator of the idea, is offering customers the free and unbiased assistance of trained domestic economists.

Miss Storey will engage and train girls on behalf of the firms concerned who will staff the bureaux. These girls will be able to offer expert advice on all matters of domestic economy from furnishing to foodstuffs, and including electrical appliances.

Retailers will agree to obtain all products recommended by the adviser when she believes they will solve a problem more efficiently than any of the products in stock. Facilities for people to test new appliances and equipment will be provided wherever possible.

Miss Storey hopes to see 12 of these bureaux in active operation this year.

NEWS IN BRIEF

Proceedings of the Glasgow Conference last year of the National Smoke Abatement Society have just been published in booklet form. It contains a report of the London Fog of 1952.

A new block of offices has been opened at their Feltham factory by Duratube and Wire Ltd.

"From Theory to Reality in Sales Management" will be the theme of I.S.M.A.'s annual conference at Buxton next month.

Cable and Wireless Ltd.'s new cable ship *Recorder* is to be launched on 3 May.

Annual outing of the Birmingham Electric Club will be to the Liverpool works of English Electric Co., Ltd., on 26 May.

Immediate and vigorous action to improve salaries was demanded at a special conference of N.A.L.G.O. delegates in London. Over 1,200 delegates represented members in local government, gas, electricity and other services in Britain.

A new £100,000 electronic computer has just been ordered by A. V. Roe Ltd., aircraft manufacturers, from Ferranti Ltd.

This year marks the 50th anniversary of the opening of the electric train service between Newcastle-on-Tyne and the east coast. The service began on 29 Mar. 1904.

World Wide Communications is the title of a booklet issued by Cable and Wireless Ltd. to commemorate the silver jubilee of the company's incorporation on 8 Apr. 1929.

New high-speed lifts have been brought into service at Hampstead Tube station on the Northern Line of the London Transport Executive. They replace older types in use since the station opened in 1907, and are the deepest of any underground station in London.

A photographer's model, Miss Joan Burgess, enhances the calendar for 1954-55 (April to March) kindly sent to us by Metropolitan-Vickers Electrical Co., Ltd.

Warning against amateurs tampering with electrical installations was given by Mr H. Moss to Bradford Engineering Society recently.

British Institute of Management has published a report in book form of their annual conference held last year at Harrogate. Price is 7s. 6d.

Immediate open access to over 3,500 scientific and technical periodicals in all languages has been provided by a new extension to the Patent Office Library in Chancery Lane, London.

Sayings OF THE WEEK

"At least one fatal accident and a large number of reportable accidents could have been avoided if lighting regulations had been carried out," . . . J. DAVIS, Inspector to Philadelphia and District Mines Inspection Board, in his quarterly report.

"The number of farms in Shropshire and Herefordshire with electricity connected has been doubled in the six years since the Midland Electricity Board was established." . . . MR. W. S. LEWIS, chairman of the Board, at Shrewsbury last week.

"I believe that the finest answer to foreign competition today comes under the heading of service and spare parts," . . . MR MILES BEEVOR, speaking at the Brush Group export sales conference.

QUESTIONS IN PARLIAMENT

Fuel Efficiency Service

ANSWERING Mr Philips Price last week the Minister of Fuel and Power said the directors, general manager and secretary of the National Industrial Fuel Efficiency Service had been appointed. The service was expected to start operating on 1 May. Details of private industrial processes entrusted to his Department would not be made available to the new company, he told Mr A. Palmer.

It was announced last week that the address of the Fuel Efficiency Service's headquarters is 71-72 Grosvenor St, London, W.1. Tel. Hyde Park 9706.

Economies

MINISTER of Fuel and Power was asked for an estimate of the fuel saved in industry as a result of using better plant and heating methods. He was also asked whether improvements in heating houses had reduced consumption or given greater amenities. He said no estimate could be given but the savings were certainly substantial. Comparable industrial fuel consumption showed a saving of about three million tons of coal a year. Improved domestic heating appeared to have resulted in greater comfort rather than reduced fuel consumption.

Import of Duty-free Machinery

THE REPORT on the duty-free entry of machinery into the U.K. was being considered in detail but it was not possible to say when it would be published or what action would be taken, Mr P. Thorneycroft said recently.

Coal Purchases

IN reply to Sir I. Fraser last week, Mr G. Lloyd said he could abolish restrictions on the purchase of coal during the summer months, but he was considering certain minor adjustments.

Gases from Power Stations

SELDOM a week passes now without mention of the alleged pollution of the air caused by power station emissions. Numerous questions were asked last week by Mr S. Hastings. He was assured that the problem of ridding flue gases of harmful sulphur oxides was already the subject of extensive research, but then asked if special attention could be given to the matter because present methods involved a large amount of water. The Thames, he said, was already saturated with the effluent of calcium sulphate when two of the power stations only were in use. Replying, Mr G. Lloyd agreed, but added that experiments were proceeding with an alternative process. As regards Barking station, Mr Lloyd said fuel consumption was declining and consequently so was the discharge of sulphur oxides. The new station would disperse its oxides at high temperature, at great velocity, and through chimneys 375 ft high—the best practical method known at present—and the old station was due for retirement.

Modernising the Railways

A NUMBER of schemes are being considered by the British Transport Commission for the modernisation of the railways, which should be brought to fruition within the next few years, the Minister of Transport told the House last week. A fresh review of the whole question of modernisation had been undertaken. Asked by Mr G. Nabarro if the importance of electrification would be borne in mind in future plans, the Minister replied "certainly."

Shop Lights Dangerous?

MINISTER of Transport said he had received very few complaints about glare from neon lighting in shop windows and in view of the lack of evidence of any danger to road users he could see no reason to take any action. Mr R. W. Sorensen had suggested there was danger and that the use of shields to prevent glare and windscreen reflection from such lighting should be encouraged.

ELECTRIC SUPPLY NEWS

Grimsby

THE six-year programme to bring a supply of electricity to every village and hamlet in North Lincolnshire has been completed. In 1948 the sub-area was set the task of supplying all the scattered rural communities in its three divisions of Grimsby, Scunthorpe and Gainsborough by the end of March, 1954. The operation of a substation supplying power to Kelstern, near Louth, has ended that work. But attention is now being turned to the many scattered farms and cottages in the area.

Inverness

THE town council is to endeavour to negotiate a special contract with the North of Scotland Hydro-Electric Board for all electricity used by corporation departments with the exception of street lighting.

Melksham

THE B.E.A. are prepared to accept a site at Daniells Wood for the erection of a new substation, even though it would cost them more to develop, the local branch of the National Farmers' Union has been told. It was decided to resist the proposals even though the Land Commissioner was in favour of the site, as were the Rural District and Parish Council, and the owners concerned, but not including the County Planning Department.

Stone

DESPITE allegations to the contrary, there is no evidence that atmospheric pollution from Meaford generating station is damaging land, crops or cattle, or in any way threatening the amenities of the nearby village of Barlaston. Those are the findings of a report presented to Stone R.D.C. by the former medical officer of health, Dr C. G. Owen, who had completed a five years' survey and investigation into the many local complaints. After referring to water for the power station being purer than that in the river itself, and the use of electrostatic precipitators to arrest ash, the report refers to sulphur dioxide being the much greater problem as no practical process exists to prevent its emission. Dr Owen's investigations, however, have revealed that they only had 3¼ parts of sulphur dioxide per 100 million parts of air, compared with 68 parts in London. Research in Canada has shown that a concentration of sulphur 0·8 parts per million would injure barley—a relatively sensitive plant. There can be, therefore, little credence given to the stories of trees blasted by sulphur, particularly when no damage can be found where the pollution is highest, the report added.

Turton

REFERRING to the B.E.A.'s proposals for the erection of the 275 kV grid line around Turton, the chairman of the District Council has said that certain suggested modifications have been agreed upon by the local authorities and are now to be submitted to the B.E.A. (Earlier the District Council had been criticised in certain quarters for not lodging objections to the proposals.)

LIGHTING SCHEMES

Buxton. Work on the second phase of conversion of street lighting from gas to electricity is awaiting approval of the M.o.T.

Heywood. Application is being made to the M.o.T. for permission to proceed with the conversion of lights in Bamford Rd.

Lancaster. The sum of £10,000 has been allocated for street lighting in Dalton Rd, Ridge La, Stirling Rd and Gregson Rd, and £5,000 for the conversion of gas lighting in part of Morecambe Rd.

Llandudno. The T.C. has provided £800 in its estimates and the Publicity Association has earmarked a further £300 for illuminations for the Centenary Year.

COMPANY ACTIVITIES

WE have had the preliminary results of B.I.C.C., the first of the mainly cable manufacturers who are dependent on the price of copper. It was also a year of stiff competition abroad. But B.I.C.C. started off the year with a full order book and have no doubt been able to work off part of that. Nevertheless, consolidated trading profits fell from the post-war peak of £9,522,000 to £8,344,000.

But Sir Alexander Roger is working well within his means. For one thing, the tax charge declined so heavily that the net profits were actually £534,000 higher. This enabled the board to consolidate the dividend at 10% by including the previous 2½% cash bonus as dividend. The 10% is covered about 5¼ times by the latest net earnings. The shareholders also get a special tax-free distribution of 2½% from sale of investments and property.

Because of the copper uncertainties and competition the outlook is a little difficult to assess, but Sir Alexander Roger is a "go-getter" and his group should also benefit from new orders arising because of Mr Butler's "Investment Allowances." The £1 units fell slightly to 42s. 6d. on the results and yield 4⅞%.

Electrical equipment shares derived benefit from the Budget, specially the manufacturers of heavy equipment. The new "investment allowances" should encourage purchasers of heavy and other electrical plant. A.E.I. went up 1s. 3d. to 47s. 9d., English Electric 3d. to 42s. 9d., Ericsons 1s. 3d. to 24s., and Radio Rentals 2s. 6d. to 54s.

A strong trading position has been built up by Telephone and General Trust, apart from the benefits to come from its associate Telephone Properties, following that company's disposal of its interest in Venezuela. The Trust has played a big part in developing telephone services overseas, notably in Portugal and the West Indies. Expansion continued last year in both principal areas of operation.

As a result, the group's income after tax rose by £15,000 to £105,000 despite a drastic fall in miscellaneous income from £18,000 to under £1,000. Dividend of 10% was an increase of 2%.

It was the operation of subsidiary companies which upset the affairs of Switchgear and Cowans last year. Profits dropped from £107,209 to £54,054, a decline which arose entirely from poor results of subsidiary companies engaged in the ferrous and non-ferrous casting trade. The Manchester foundry had to be closed and iron castings concentrated at Bangor. On top of that the lease of the non-ferrous foundry and pattern shop expired last year and could not be renewed. This undertaking, too, had to be transferred to vacated iron foundry premises in Manchester with consequent heavy removal costs and reduction in profit due to interruption of production. Demand for iron castings has now improved, the re-organisation of the non-ferrous foundry completed, and the company look forward to a steady improvement in results. The directors feel that the 1953 results were only a temporary set-back and future results will justify their development policy, but they are wise to reduce dividend and not to denude the reserves.—*From our City Correspondent.*

Barbados Electric Supply Corpn. Ltd.

For the year ended 30 June last, the trading profit, etc., amounted to £56,801, compared with £61,936 for the previous period. Units sold during the period totalled 13·8 million, an increase of 1·4 million, but higher costs, especially in the power station where much extra work has been in progress, caused the reduction in trading profits. Further extensions are planned for the financing of which the directors hope shortly to announce the completion of arrangements.

British Insulated Callender's Cables

With a final dividend of 7½%, the total is again 10% for the year, but there is this time added a special distribution of 2½% (untaxed) from realised capital profits. The group trading profit for the year ended 31 Dec. last is £8,344,074—a reduction of £1,178,002 on the previous year's figure—but as the taxation charge is over £2 million lower, the net profit amounts to £3,998,336 compared with £3,464,435 a year previously.

Jerusalem Electric & P. S. Corpn. Ltd.

It is shortly hoped to present detailed proposals involving the reorganisation of the Jordan undertaking, which at present, as the result of the segregation of the Corporation's assets and liabilities, has an authorised capital of Jordan dinars 600,000, divided into 225,000 7% cumulative Preference, 300,000 Ordinary and 75,000 undenominated shares—whereas the Israel company has identical shareholding expressed in Israel pounds. The proposals will provide, *inter alia*, for the reduction of the capital of the Jordan company to a figure more closely related to the value of the assets there.

Rheostatic Co. Ltd.

In spite of some limitation in the demand for thermostats for domestic markets, turnover increased slightly last year. The company now has a much more satisfactory order book than a year ago, Mr M. J. Gartside, the chairman and managing director states. The subsidiaries in France and South Africa maintained their profit figures despite some recession in trade and a new subsidiary has commenced trading in Canada. The company is planning means of increased production to enable it to continue to command its share of the various markets, but Mr Gartside warns that it is difficult to judge now whether this additional turnover will result in an increase to or even maintenance of, the level of profit attained in the past two years.

Year to 30 Sept.	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1949	108,648	30,338	34	16*	11/10	9/1
1950	140,101	43,435	50	16½	8/4	6/6
1951	189,649	52,697	52	16½	11/6	8/–
1952	254,787	88,800	69	19	8/9	7/7
1953	229,096	72,547	52	20	12/–	8/1

*Plus 50% Capital bonus.

Switchgear and Cowans Ltd.

The directors feel that the results for 1953 are only a temporary set-back. In fact, output last year was 27% higher than in 1952, but the very heavy re-tooling programme undertaken absorbed the profit arising from the increased production, Mr J. E. Chamberlain, the chairman, explains. The benefits of that programme were obtained only during the last quarter of the year. Now that the undertaking has been completed the company looks forward to a period when production of certain types of gear, much in demand, will be increased and delivery periods reduced. Of the subsidiary companies, the insulation factory had a good year, but the ironfoundry was seriously affected by the reduced demand.

Year to 31 Dec.	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1949	91,806	25,806	31	20	18/9	11/–
1950	99,320	24,847	30	22½	15/10	13/9
1951	138,481	34,273	43	22½	17/7	14/10
1952	166,687	22,549	24	22½	15/–	12/6
1953	114,697	12,344	13	10	16/9	12/6

Telegraph Construction and Maintenance Co. Ltd.

A final dividend of 3¼% plus a bonus of 1%, is recommended, making a total of 8½% on the larger capital, against 9¼% previously. The group profit for 1953 is £222,584, which is £23,235 higher than a year ago.

Watford Electric and Manufacturing Co.

There was a final dividend of 10% plus a bonus of 7½%, on capital which has been increased by 60% scrip issue. The interim of 5%, already paid, was on the smaller capital. For 1952 there was a total distribution of 25%. The trading profit for 1953 is £79,811 compared with £85,391 for the previous year, and the net profit, after tax, is £36,457 (*£24,475*).

Dividends Declared

Parmiter Hope and Sugden. Interim of 7½% (*same*).

Permali Ltd. Interim of 4%.

Herbert Morris Ltd. Interim of 5% (*same*) tax free and on larger capital.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are final for receipt of tenders unless otherwise stated.

16 Apr.—Edinburgh T.C. Electrical work in 130 houses in Clermiston Development.—See 8 Apr. issue.

16 Apr.—Kincardine. Installation at Catterline primary school.—See 8 Apr. issue.

16 Apr.—Londonderry. Installation at Magherafelt intermediate school.—See 25 Mar. issue.

17 Apr.—Galashiels T.C. Street lighting units in Channel, Market and Paton Sts. —See 25 Mar. issue.

17 Apr.—Richmond (Yorks.) R.D.C. Pumping plant.—See 18 Mar. issue.

17 Apr.—Durham. Installation in 16 houses.—See 1 Apr. issue.

19 Apr.—Ellesmere Port U.D.C. Concrete street lighting columns and totally enclosed lanterns.—See 8 Apr. issue.

21 Apr.—Fifeshire. Installation in High School at Kirkcaldy.—See 25 Feb. issue.

21 Apr.—Newcastle-on-Tyne T.C. Washing and mangling machines for Hindhaugh St flats.—See 8 Apr. issue.

22 Apr.—Seaton Valley U.D.C. Supply of electrical goods for 154 houses. Surveyor to Council, Council Offices, Seaton Delavel, Northumberland.

23 Apr.—Birmingham T.C. Installation of lifts and lighting and power in blocks of flats on Holly Bank Farm estate.—See 1 Apr. issue.

23 Apr.—Durham. Electrical installation in 11 police houses on Owton Manor estate, West Hartlepool. G. R. Clayton, county architect, Court La.

23 Apr.—Falmouth T.C. Installation of electricity in 260 houses on Old Hill, Beacon and Trescobeas estates and at Berkley Cottages. Borough Engineer, Municipal Offices.

23 Apr.—Heckmondwike U.D.C. Installation in 14 houses on Dale Lane estate. —See 1 Apr. issue.

24 Apr.—Ashington (Northumb.) U.D.C. Installations and supply of cookers in houses on Darnley Rd site.—See 8 Apr. issue.

24 Apr.—Carlisle T.C. Electrical installation in 203 houses. City Engineer, L. J. A. Stow, 18 Fisher St.

24 Apr.—Durham. Lighting and power installation at Crossgate Hospital for Hospital Management Committee. Group Secretary, Dryburn Hospital, Durham.

26 Apr.—Goole T.C. Concrete and steel columns, lanterns, flashing beacons, etc. —Advertised in 8 Apr. issue.

26 Apr.—Lanark T.C. Supply, erection, etc., of 55 lighting units along route A73. —See 1 Apr. issue.

26 Apr.—West Riding. Rewiring of Bentley New Village school; and conversion to electricity at Pontefract Love Lane School.—See 1 Apr. issue.

27 Apr. — Peterborough T.C. Steel columns and lanterns and cast-iron columns and lamps along various roads. See 8 Apr. issue.

28 Apr.—Swansea T.C. Installation in fire station in Grove Place.—Advertised in 8 Apr. issue.

29 Apr.—Kingston-on-Thames T.C. Erection, wiring etc. of 15 street lighting installations in group B along four roads. Also same as regards 19 steel columns (25 ft) and fittings in group A along Cromwell Rd and Birkenhead Ave; dismantling of 10 units included in latter. Separate contracts. Borough Surveyor, Guildhall. Deposit £2. 2s. in each case.

29 Apr.—Southall T.C. Supply of 159 lanterns, 140 W sodium vapour discharge lamps and auxiliary equipment, and 157 concrete columns including erection and installation of all equipment. Contracts may be let separately or together. Borough Engineer, Town Hall. Deposit £2. 2s.—Advertised in this issue.

30 Apr.—Fifeshire. Electrical installation in 40 houses at Kinglassie and 18 at Carnock. James Gentles and Son, chart. quantity surveyors, Central Chambers, Kirkcaldy.

30 Apr.—Sheffield T.C. Electrical installation in total of 1,025 dwellings in a number of building schemes on Greenhill-Bradway estate. J. L. Womersley, City Architect, Town Hall. Deposit £2.

30 Apr.—Wakefield. Lighting installation in Carlton St Primitive Methodist Church and Sunday School. Mr Ashton, 40 Town St, Carlton.

1 May—Bury T.C. Erection of about 412 steel columns and fitting and wiring of sodium street lighting equipment. Street Lighting Superintendent, Hacking St.—Advertised in this issue.

3 May—Manchester T.C. One 20 cwt electrically operated goods lift for New Central Stores, "Newholme." City Architect, Town Hall. Deposit £1. 1s.—Advertised in this issue.

3 May—West Riding. Rewiring at Barnoldswick C.E. school. County Architect, Bishopgarth, Westfield Rd, Wakefield.

3 May—West Riding. Rewiring at Liversedge Littletown county school. County Architect, Bishopgarth, Westfield Rd, Wakefield.

3 May—West Riding. Rewiring at Mexborough Roman Terrace and Tadcaster schools.—See 1 Apr. issue.

7 May—Belfast T.C. Supply of primary current injection testing set. Tender No. W.32. Electricity Dept., East Bridge St. Deposit £1. 1s.—Advertised in this issue.

7 May—Belfast T.C. CO_2 fire fighting equipment.—Advertised in 1 Apr. issue.

10 May—Birmingham. Supply, erection, etc., of three electrically driven air compressor sets at Minworth works, for Tame and Rea District Drainage Board. Engineer to Board, Rookery Park, Erdington, Birmingham 24.

17 May—Glasgow T.C. Supply of 28 electric traction batteries for cleansing dept. Details from 33 Stockwell St, Glasgow C.1.

17 May—Stepney B.C. Installations in flats in Sidney St. scheme.—Advertised in 1 Apr. issue.

17 May—West Riding. Rewiring (during school holidays) of Aldwick-le-Street Highfields school. County Architect, Bishopgarth, Westfield Rd, Wakefield. Deposit £2. 2s.

24 May—Stourbridge T.C. Electrically and diesel driven vertical spindle centrifugal pumps at Enville St pumping station.—See 8 Apr. issue.

26 May—Durham. Electrical installation in 144 houses at Acre Rigg for Peterlee Development Corpn. A. V. Williams, general manager of Corpn., Shotton Hall, Castle Eden.

No date stated—Belfast. Electrical installation in St. Colman's primary school, Eliza St. G. I. O'Gorman, architect, 2 College Sq. North, Belfast. Deposit £3. 3s.

. . . and Overseas

Details of items marked may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.*

10 May—India. Supply of three 5 MVA. to 10 MVA and two 15 MVA 132-33 kV 3-phase power transformers for substations of Damodar Valley Corporation. Specif. No. ED-712-2. Corporation's Chief Electrical Engineer, Anderson Hse, Calcutta 27, at Rs 50 a copy.

11 May—U.S.A. Supply and installation of 110,000 kVA 95% power-factor, 180 r.p.m. 16,500 V, 60 c/s, vertical-shaft a.c.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries

A Selection from the 112 queries answered this week

"Segic" soldering irons, suppliers of? T.B.—S. Guiterman and Co., Ltd., 37 Soho Sq, W.1.

"Lorsant" electrically-heated clothing, suppliers of? W.M.S.—Sondan Co., 107 Gt. Eastern St, E.C.2.

Combined switch and blanking-off louvre-operating mechanism, makers of? E.E.I. —Woods of Colchester Ltd., Colchester.

"Earilmil" blower units, makers of? A.M.E.—We presume this refers to a part of the system made by: Earleymil Ltd., 212a Shaftesbury Ave, W.C.2.

"Regulite" pedestal lamps, makers of? W.L.T.—P. W. Baker and Sons Ltd., 5/15 Ten Bell Lane, Birmingham 19.

Bottle "Viskring" sealing-in apparatus, makers of? L.E.B.—This is an infra-red heating application by the Metropolitan Vickers Electrical Co., Ltd., 1/3 St. Pauls Churchyard, E.C.4.

"Brent" piglet foster mother, makers of? T.E.—Churn Co., Station Rd, Hailsham, Sussex.

ANSWER WANTED

Cogs for a German drill marked A.M.D. or R.M.D. suppliers of? C.J.H.

generators and spares, for Bureau of Reclamation, Denver Federal Centre, Denver, Colorado. (No. D.C.-4144). B.o.T. (Ref.: ESB 9103/54).*

May—Iraq. Directorate-General of Municipalities, Baghdad, invite tenders for supply of one 100 kW d.c. generating set at Kifri, closing day 10 May; and also for two 500 kW alternator sets at Saadiya, and one 50 kW and one 25 kW alternator set at Mahaweel, closing date 13 May. Deposit I.D. 500s. B.o.T. (Ref.: ESB 8223/54).*

17 May—Iraq. Directorate General of Municipalities at Baghdad, requires supply and erection at Khider, Diwaniya Liaw, of two alternator sets 50 kW each, with switchgear. Documents (Notice 17) from Directorate's Accountant at 1D-/500 per copy.

18 May—New Zealand. Supply of 4.000 switchboard lamps, 17-18 V. for Stores Div., G.P.O., Windsor Building, Willis St, Wellington. Tender No. P and T 150/6908. B.o.T. (Ref.: ESB 8978/54).*

20 May—India. Supply of 22 kV, 6·6 kV and 660 V underground cables and accessories during six months from 1 July. Controller of Stores, Electric Hse, Fort, Bombay. Rs 15s. per set.

29 May—Portuguese W. Africa. Supply and erection of five silos in Angola and equipment for upkeep and loading of railway wagons, and electric generators to operate the plant. Maize Guild of Overseas Territories. B.o.T. (Ref.: ESB 8129/54).*

31 May—Iraq. Supply and erection at Sulaimaniva of two alternator sets 280/300 kW each with transformers, control panels and switchgear (Tender notice 17). Documents from Accountant of Directorate General of Municipalities, Baghdad, at ID-/500 per copy. B.o.T. (Ref.: ESB 8833/54).*

13 June—New Zealand. Tenders (No. 256) invited by State Hydro-Electric Department for supply of two 312·5 kVA auxiliary generating sets for Atiamuri power station. Documents available at N.Z. Government Offices in London.

15 June—New Zealand. Supply of electrical fittings and 4,600 ft of conduit (P and T 150/6805) for Post and Telegraph Department, Wellington. B.o.T. (Ref.: ESB 8841/54).*

16 June—Australia. State Electricity Commission of Queensland requires (Tender No. 435) supply of 11 kV metal clad switchgear for Wide Bay-Burnett Electricity Board. Secretary of Commission, Scottish Union Hse, Eagle St, Brisbane. B.o.T. (Ref.: ESB 8578/54).*

22 June—New Zealand. State Hydro-Electric Department requires supply (Contract No. 255) of three 23.334 kVA 220/11 kV transformer banks and spare unit for Atiamuri power station. Documents available at N.Z. Government Offices in London.

Contracts Placed

Bermondsey B.C. Improved street lighting along A.100 and A.200 (involving G.E.C. lanterns and Concrete Utilities columns). Erecon Ltd., £14,971.

Exeter T.C. Supply and erection of lanterns, chokes, etc., erection of concrete columns for main street lighting, Revo Electric Co., Ltd., £4,397.

Newcastle-on-Tyne. Installation of lifts at pathological institute and blood transfusion centre at General Hospital, Evans Lifts Ltd., £10,411.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, 13 April

	£ per ton	Weekly change £	Price last year £
COPPER, standard class A (settlement)	245	+9½	280
,, (3 months)	233½	+5½	—
LEAD, refined pig, min. 99·97% purity (cash)	95½	+2½	84½
,, (3 months)	93½	+1½	81½
TIN, refined, min. 99·75% purity (settlement)	787½	+27½	702½
,, (3 months)	770	+49	692½
ALUMINIUM, ingots 99-99·5%	156	—	161
ZINC, virgin, min. 98% purity (cash)	81	+1½	73½
,, (3 months)	80½	+1½	74½
RUBBER No. 1, RSS, spot (per lb)	17⅞d.	—	19¾d.
,, c.i.f. basis, ports, June (per lb)	17 $\frac{29}{32}$d.	−½	19¾d.
ARMOURING:			
Galv. Steel Wire (0·104 in.)	52	—	51½
Mild Steel Tape (0·014 in.)	40½	—	40

TRADE NOTES

Changes of address: H. E. Drabble, electrical, radio and t.v. installation engineer, has moved to larger premises at Cambridge Hse, 25 Market St, Staveley, nr Chesterfield.

The Bristol office of the Hotpoint Electric Appliance Co., Ltd., has moved to 1, 3 and 5 St. Stephen St, Bristol (telephone Bristol 28606). The service depot is at Building 75, Whitchurch Airport, Bristol (telephone Bristol 26451, ext. 331).

The Electrical Branch of the Factory Department of the Ministry of Labour and National Service, has now moved to 40/41 York Terr., Regents Pk, N.W.1. (Telephone Museum 5030.)

New premises. Ekco-Ensign Electric Ltd. have opened new premises at 68 Caroline St, Birmingham. (Telephone Central 2997).

London Stores and Showrooms. On Wednesday next, Wandleside Cable Works Ltd. are opening London stores and showrooms at 30 Tottenham St, W.1. Telephone Museum 1838.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

AA design. B723,720. Class 9. Lighting apparatus and appliances, Ashley Accessories Ltd., Morecambe Rd, Ulverston, Lancs.

Bromar. 722,763. Class 9. Electrically operated devices for giving warning of defects in vehicle lighting systems, J. Bromley and J. R. G. Marshall, 150 Medway Rd, Gillingham, Kent.

Glyndova. 722,736. Class 7. Sawing and woodworking machines, winches, cranes, pumps, presses, motors, dynamos, boilers, etc. Glyndova Ltd., 45/47 George St, W.1.

Industrial Sewing Machines Ltd., in design, B726,529. Class 7. Sewing, cloth cutting and pressing machines, etc., Industrial Sewing Machines Ltd., 66/68 Wade La, Leeds 2.

Magna. 726,347. Class 11. Water heaters for use in making beverages, James Stott and Co. (Engineers) Ltd., Vernon Works, Oldham.

Micronector. 726,242. Class 9. Plugs, sockets and switches, McMurdo Instrument Co., Ltd., 10 Upper Berkeley St, W.1.

Montuft. 727,007. Class 7. Sewing machines, etc., J. and W. Thorp and A. D. Simcock, Dane Bank Works, Windmill La, Denton, Lancaster.

Gazette Announcements

COMPANIES ACTS

Milnes Radio Co., Ltd. Meeting of members and creditors will take place at Chamber of Commerce Offices, Commerce Hse, Cheapside, Bradford, on 14 May at 3.30 p.m. and 3.45 p.m. to receive liquidator's report.

Belco London Ltd. Resolution for voluntary winding-up passed at meeting on 31 Mar. D. Winter, F.C.A., of John M. Winter and Sons, 39 St. James's St, London, S.W.1, was appointed liquidator.

BANKRUPTCY ACTS

First Meetings and Public Examinations

Bristol. Anthony G. Dunn, electrician and car dealer of The Bungalow, Water La, and 3 Glen View Rd, Brislington, Bristol. First meeting takes place today (15 Apr.) at Official Receiver's Office, 26 Baldwin St, Bristol, at 11 a.m. Public examination will be at The Guildhall, Small St, on 18 June at 10.30 a.m.

Liverpool. Herbert Pryor, electronic engineer trading as W. Pryor at 36 Low Hill, Liverpool. Public examination will be at The Court Hse, Fruit Exchange Buildings, Victoria St, on 1 June at 10.30 a.m. First meeting took place yesterday (Wed.).

Release of Trustee

Birmingham. Hugh Brash Campbell trading as Electronic Trade Services at 2170 Coventry Rd, at 227a Golden Hillock Rd, Small Heath, Birmingham, and at 2-4 Little Peter St, Manchester. Trustee was R. K. Clark, Official Receiver, Somerset Hse, 37 Temple St, Birmingham.

Torquay. Stanley A. Cooper, electrical engineer of 17 St. Margaret's Rd, St. Marychurch, Torquay. Trustee was G. W. Sisman, Official Receiver, 26 Baldwin St, Bristol.

Wandsworth. John A. Wagthorn, electrical engineer and contractor trading at 91 Eccles Rd, S.W.11. A. E. Attwood, acc., 20-21 Lawrence La, Cheapside, E.C.2, was trustee.

Intended Dividends

Brighton. James W. Luker and Henry A. R. Phillips, electrical contractors trading as Gordon and Luker, at East St, Lewes, and 206 High St, Lewes. Last day for receiving proofs, 21 Apr. Trustee is J. S. Bradley-Hole, cert. acc., 7 Old Steine, Brighton.

BUSINESS PROSPECTS

Antrim. Construction of 108 houses in Crumlin Rd. N. Ireland Housing Trust, 12 Hope St, Belfast.

Belfast T.C. Erection of four blocks containing 27 flats on Henderson Ave site. Housing Architect's Dept., 94 Chichester St.

Cheltenham. Dowty Equipment Ltd. are planning to erect factories at Arle Court and Ashchurch.

Chislehurst and Sidcup (Kent) U.D.C. Erection of block of 30 flats and two blocks of eight flats at St. Paul's Cray. T. W. Fagg, clerk of council, Council Offices, Sidcup Pl, Sidcup.

Dagenham T.C. Construction of 74 houses, 14 bungalows, 8 flats, etc., on Marks Gate estate. Borough Engineer and Surveyor, Civic Centre.

Downpatrick U.D.C. Erection of 52 houses in Saul St and 28 in Lr John St. Town Surveyor, Irish St.

Dumfries. Western Hospital Board seeking approval for plans for major reconstruction of Cresswell Hospital. Cost estimated at £159,400.

East Sussex. Erection of West Bletchington C.P. infants' school at Hove. County Architect. County Hall, Lewes.

Edinburgh. Dean of Guild Court has approved erection of factory at Sighthill for Eldorado Ice Cream Co., Ltd.

Glasgow. Approval sought for Western Hospital Board's plans for out-patients' department at Victoria Infirmary (£19,680); radiotherapeutic department at Western Infirmary (£250,000); and maternity unit at Robroyston Hospital (£500,000).

Harrow. T. P. Bennett and Son, 43 Bloomsbury Sq, W.C.1, are architects for new laboratories proposed by Kodak Ltd.

Kilkenny T.C. Erection of 68 houses in Walkin St. Consulting architect, J. C. Thompson, 65 O'Connell St, Limerick.

London. R. P. Sharman, 55 Queen Anne St, W.1, is architect for rebuilding Brilliant Sign Ltd.'s factory in Uxbridge Rd, W.12.

Londonderry. Erection of Milburn primary school, Coleraine; and Greystone Hall special school, Linavady. Crofton G. Dalzell, quantity surveyor, The Diamond, Coleraine.

Newtownards (Down) T.C. Erection of 21 dwellings in Scrabo Rd. W. C. Scott, town clerk, Town Hall.

N. Ireland. Erection of 34 dwellings at Warrenpoint. N.I. Housing Trust, 12 Hope St, Belfast.

North Riding. Erection of new county primary school at Northallerton. F. Barraclough, County Hall.

Norwich T.C. Construction of 253 dwellings on Heartsease estate. City Architect, City Hall.

Port Glasgow. Erection of 46 houses on Park Farm site. Scottish Special Housing Association Ltd., 15-21 Palmerston Pl, Edinburgh.

Ruislip (Middx.). Proposed erection of repair depot for fire and ambulance services is estimated to cost £179,550.

Runcorn U.D.C. Erection of 66 dwellings on Penn Lane estate and 43 on Windsor Grove estate. Engineer and Surveyor, Town Hall.

Spalding U.D.C. New Windsor estate to be developed this year.

Tipton (Staffs.) T.C. Tenders may soon be invited for erection of multi-storey block of flats on Park Lane East site.

Walsall T.C. Erection of 68 dwellings on Gipsy Lane estate. M. E. Havershon, borough engineer and surveyor, Council Hse.

York T.C. Estimate to be obtained for installation of electricity in Clifton C.E. controlled school.

Overseas

Belgium. Domestic electrical appliances and electrically operated small tools are among items in which Ets. John Graham and Co., S.A., 231 Avenue Louise, Brussels, are interested in representing U.K. manufacturers.

Italy. Project for airfield construction in Italy is envisaged. Work involves airfield lighting and U.K. firms are advised to contact Ministero della Difesa-Aeronautica, Direzione Generale Demanio, Vial Castro Preborio-Roma, as soon as possible.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.

Allied Control Co., Ltd. To acquire patents, etc. Power is taken to carry on business of manufacturers of and dealers in dynamos, motors, relays, armatures, etc. Nom. cap.: £100. Dirs.: to be appointed by subscribers. Subs.: H. E. Collins, 140 Junction Rd, Burgess Hill, Sussex, and H. L. Armstrong, 65 Brook Cres, Chingford, E.4.

F. Gray (North Shields) Ltd., 73 Church Way, North Shields. Electricians, mechanical engineers, manufacturers of and dealers in electrical apparatus, etc. Nom. cap.: £1,000. Dirs.: F. Gray and Isabel Gray.

Humber Refrigeration Ltd., St. Andrew Dock, Hull. Manufacturers of and dealers in refrigeration plant, etc. Nom. cap. £100. Dirs.: W. H. Ashton and S. Nowell, junr.

Leigh Electronic Developments Ltd., 56 Vicarage Lane, Ilford, Essex. Electricians, electrical and electronic engineers, etc. Nom. cap.: £10,000. Dirs.: A. G. Clark, G. C. Gaut and A. R. Rangabe.

Modern Lighting and Radio Co., Ltd., 212 High St, N.16. Nom. cap.: £2,000. Dirs.: H. Ruda and Carol Ruda.

S. and B. Electronics Ltd., 185 Wardour St, W.1. Manufacturers of and dealers in electrical and mechanical apparatus, etc. Nom. cap.: £100. M. Sands signs as director.

North Eastern Instrument Co., Ltd., Durham Rd, Low Fell, Gateshead. Manufacturers of and dealers in optical, mechanical, electrical, physical, mathematical and photographic instruments, etc. Nom. cap.: £5,000. Permt. dirs.: J. A. Hall and Mrs. E. Hall.

Temlow Electronics Ltd. Offices of Alfred Bieber and Bieber, 1 Broad St, Pla, Finsbury Cir, E.C.2. Nom. cap.: £100. Dirs.: F. E. Templeman and F. A. Marlow.

Vulcanised Fibre, Ltd., Holbrook Hse, Shalford, nr. Guildford, Surrey. To take over business of manufacturers of vulcanised fibre, leatheroid, etc., now carried on by Vulcanised Fibre, Ltd. (incorporated on May 30, 1927) at Guildford, Surrey, manufacturers of and dealers in paper of all sorts and all articles made from paper or pulp, etc. Nom. cap.: £150,000. Permt. dirs.: A. F. Jacobs, F. A. Greene and F. V. Barber.

Peter Wilkins Ltd., 7 Cambridge Rd, Hastings, Sussex. Radio, electrical and model engineers, etc. Nom. cap.: £1,000. Dirs.: P. E. Wilkins, D. B. Rilot and R. Sturdy.

Universal Electrical Service (Walsall) Ltd., Bath St, Walsall, Staffs. To take over business of conduit manufacturers carried on as Universal Electrical Service at Bath St, Walsall, by Joe Holmes and Anthony M. Holmes. Nom. cap.: £10,000. Dirs.: J. Holmes, A. M. Holmes, D. T. Wigley and Mrs A. Pursehouse.

L. Wagstaff and Sons (Engineers) Ltd., Florence St, Sale, Cheshire. Electricians, engineers, radio engineers, experts and contractors, etc. Nom. cap.: £2,000. Dirs.: L. Wagstaff and Mrs. J. L. Wagstaff.

MEETINGS TO NOTE

THURSDAY, 15 APR.

I.E.S. (Glos. and Cheltenham).—Annual meeting at G.E.C. Ltd., 2 St. Aldate St, Gloucester, 6.30 p.m.

INCORP. PLANT ENGRS. (Blackburn).—"Thermal Insulation in Medium Temperature Range," C. Jolley. Grosvenor Hotel, 7.30 p.m.

TUESDAY, 20 APR.

I.E.E. (S.E. Scotland).—Annual meeting at Carlton Hotel, Edinburgh, 7 p.m.

I.E.S. (Liverpool).—"Sports Lighting," M. W. Peirce. Elect. Offices, Whitechapel, 6 p.m.

WEDNESDAY, 21 APR.

I.E.E. (Sheffield). — Annual meeting. "Logical Approach to Problems of Electric Space-Warming," D. H. Parry. Grand Hotel, 6.30 p.m.

I.E.S. (N. Lancs).—Annual meeting at Elect. Offices, 19 Friargate, Preston, 7.15 p.m.

BRIT. INSTN. OF RADIO ENGINEERS (London).—"Crystal Valves in Radio and Electronics," B. R. A. Bettridge. School of Hygiene, Keppel St, W.C.1, 6.30 p.m.

INCORP. PLANT ENGRS. (Glasgow).—"Hospital Heating: modern methods," W. Russell. 425 Sauchiehall St, 7 p.m.

INCORP. PLANT ENGRS. (Western).—"Gas Turbine Locomotive." Grand Hotel, Bristol, 7.15 p.m.

A.S.E.E. (Southampton). — "Joints for Power Cables." B. A. Maxted. Polygon Hotel, 8.15 p.m.

THURSDAY, 22 APR.

I.E.E. (London Utilisation).—"Safety in Use of Portable and Transportable Electrical Equipment in Industry," J. Bunting. Savoy Place, W.C.2, 5.30 p.m.

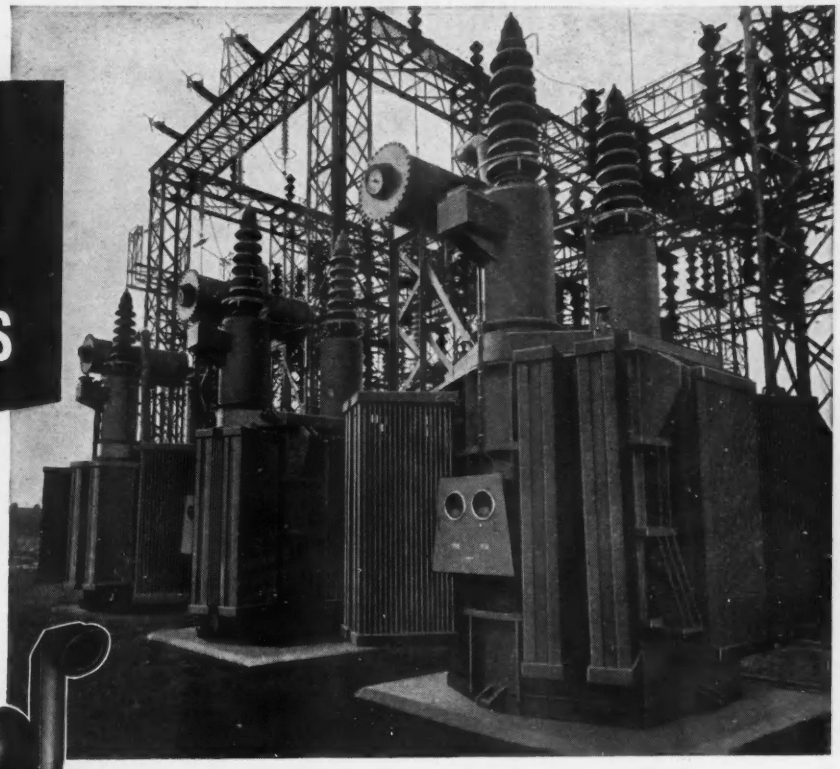
FRIDAY, 23 APR.

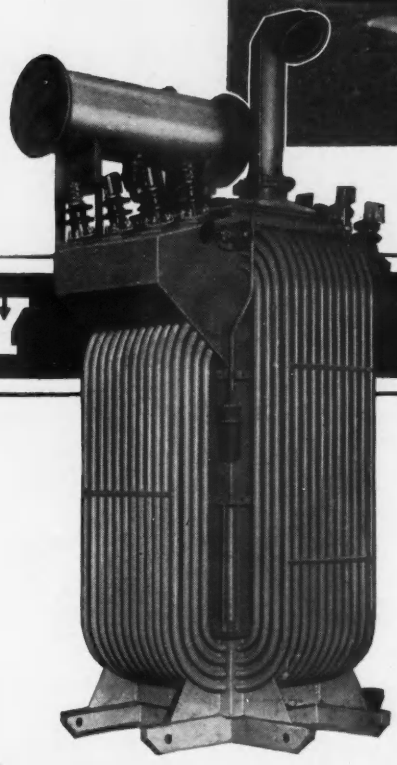
I.E.E. (London Education).—Discussion on "Method for Plotting of Magnetic Fields due to Currents," F. T. Chapman and D. G. Sandeman. Savoy Place, W.C.2, 5.30 p.m.

I.E.S. (Bath and Bristol).—Annual meeting and film show at Elect. Offices, Old Bridge St, Bath, 7 p.m.

INSTN. OF MECHANICAL ENGRS.—James Clayton Paper on "New Frontier: Air Pollution Control." F. S. Mallette.

CURRENT LIMITING REACTORS





BY HACKBRIDGE

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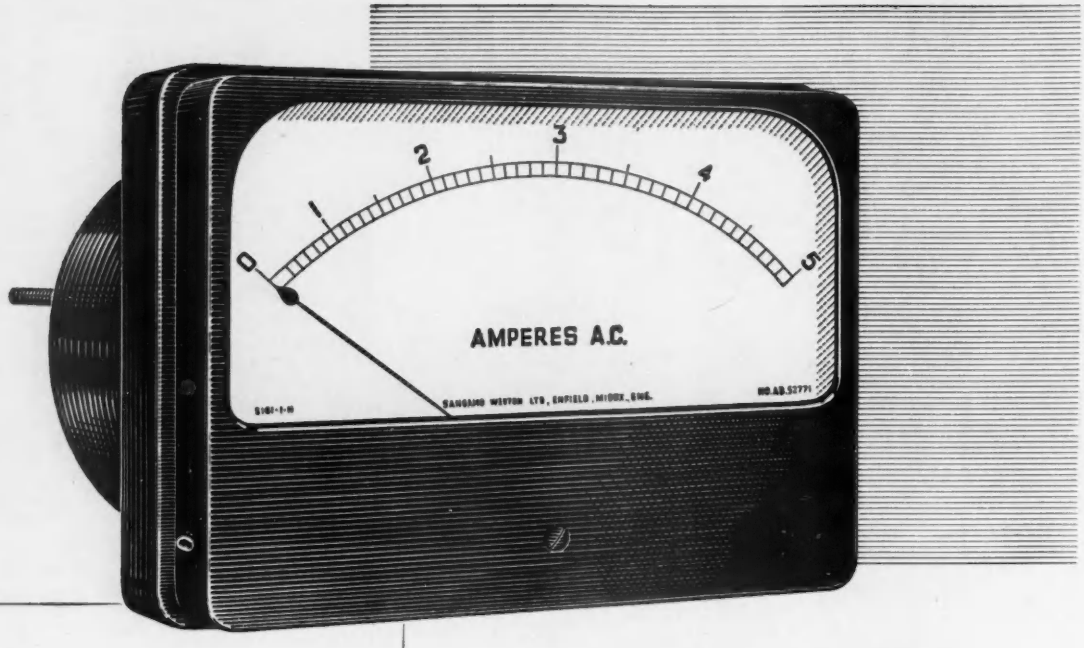
Telephone: Walton-on-Thames 760 (8 lines) *Telegrams: "Electric, Walton-on-Thames"*

OVERSEAS REPRESENTATIVES

ARGENTINA: H. A. Roberts & Cia., S.R.L. Buenos Aires. AUSTRALIA: Hackbridge and Hewittic Electric Co., Ltd., Sydney. BELGIUM & LUXEMBOURG: M. Dorfman, 124, Avenue des Cerisiers, Woluwé 1, Brussels. BRAZIL: Oscar G. Mors, Caixa Postal 1280, Sao Paulo. CANADA: Hackbridge & Hewittic Electric Co. of Canada Ltd., Montreal, etc. CHILE: Ingenieria Electrica S.A.C., Santiago. EAST AFRICA: Gerald Hoe & Co., Private Bag, Nairobi. EGYPT: Giacomo Cohenca Fils, S.A.E., Cairo. FINLAND: Sähkö-ja Koneliike O.Y. Hermes, P. Esplannaadikatu 37, Helsinki. HOLLAND: J. Kater E.I., Ouderkerk a.d. Amstel, Amsteldijk Noord 108c. INDIA: Steam & Mining Equipment (India), Ltd., Calcutta; Easun Engineering Co., Ltd., Madras, 1. IRAQ: J. P. Bahoshy Bros., Baghdad. MALAYA, SINGAPORE & BORNEO: Harper, Gilfillan and Co., Ltd., Kuala Lumpur. NEW ZEALAND: Richardson, McCabe & Co., Ltd., Wellington, etc. PAKISTAN: James Finlay & Co., Ltd., Karachi. TRINIDAD & TOBAGO: Thomas Peake & Co., Port of Spain. TURKEY: Dr. H. Salim Oker, Karanfil Sokak 59, Ankara. URUGUAY: H. A. Roberts & Cia., S.A.U., Montevideo. U.S.A.: Electro Machinery Corporation, 50, Broad St., New York, 4.



WESTON ELECTRICAL INSTRUMENTS INCLUDE:–

LABORATORY STANDARDS

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FIRST GRADE PORTABLE INSTRUMENTS

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PORTABLE TEST SETS

RELAYS

AIRCRAFT INSTRUMENTS

THE WESTON RANGE OF RECTANGULAR INSTRUMENTS

These instruments, giving the advantage of long, easily read scales, are designed to harmonize with rectangular panels and are offered in a variety of types and scale ranges.

Supplied as D.C. moving coil, A.C. rectifier and H.F. thermocouple types; also A.C./D.C. moving iron types.

Four sizes are available with scale lengths of 2·5″, 3·2″, 4·2″ and 6·25″.

Front of panel or back of panel mounting may be adopted as desired and if the former method is used, there is complete interchangeability with existing round models.

The 3·2″ and 4·2″ scale instruments are available with either illuminated or non-illuminated dials; the 2·5″ and 6·25″ scale instruments being available only with non-illuminated dials.

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CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s

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TENDERS INVITED

BOROUGH OF SOUTHALL
Improvement of Street Lighting in Uxbridge Road (A.4020)

TENDERS are invited for the provision of the following:

(a) 159 No. lanterns.

(b) 159 No. 140 watt sodium vapour discharge lamps and ancillary electrical equipment.

(c) 157 No. concrete columns 25 ft high, including erection, together with the installation of all electrical equipment.

Contractors tendering should allow for the fact that contracts may be let separately for (a), (b) and (c).

Copies of Form of Tender, Specification and Bills of Quantities may be obtained from, and Conditions of Contract and Drawing inspected at, the Office of the Borough Engineer, Town Hall, Southall, on payment of £2. 2s. which will be refunded on receipt of a bona fide tender.

Tenders should be delivered to the undersigned, together with all technical information required in the envelope provided, which should bear no indication of sender, not later than 12 noon on Thursday, 29 Apr., 1954.

The Council do not bind themselves to accept the lowest or any tender.

J. S. SYRETT,
Town Clerk.

Town Clerk's Office,
South Rd.,
Southall, Middlesex. (H 447)

COUNTY BOROUGH OF SWANSEA
New Fire Station, Grove Place, Swansea

TENDERS FOR ELECTRICAL INSTALLATION

FIRMS wishing to Tender for the Electrical Installation at the New Fire Station to be erected at Grove Place, Swansea, are invited to submit their applications to the Borough Architect, The Guildhall, Swansea, on or before Wednesday, 28 Apr., 1954.

Plans, Specifications and Conditions of Contract can be obtained on application and deposit of £2, provided the applicant gives satisfactory evidence of having previously carried out work of a similar character.

The deposit will be refunded after delivery of a bona fide Tender (which is not subsequently withdrawn) and the return of all documents.

No guarantee is given that the lowest or any other Tender will be accepted.

T. B. BOWEN,
Town Clerk.

The Guildhall,
Swansea. (H 381)

CITY OF BELFAST
Electricity Department

PRIMARY CURRENT INJECTION TESTING SET

TENDERS are invited for the supply and delivery of a primary current injection testing set.

Form of Tender and specification (No. W.32) may be obtained at the Electricity Department, East Bridge St, Belfast, on payment of a deposit of one guinea which will be refunded provided a bona fide Tender is lodged and not withdrawn. Extra copies

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may be obtained at half a guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each Tender, in sealed envelope marked "Tender for Primary Current Injection Testing Set, Electricity Committee," and endorsed with the name and address of the tenderer, must reach the undersigned not later than 4 p.m. on Friday, 7 May, 1954.

An official receipt must be obtained for each Tender delivered by hand. Tenders sent by post should be registered.

The lowest or any Tender will not necessarily be accepted.

JOHN DUNLOP,
Town Clerk.

City Hall, Belfast,
9 Apr., 1954. (H 471)

COUNTY BOROUGH OF BURY

TENDERS are invited for the erection of approximately 412 steel street lighting standards and the fitting and wiring of sodium lighting equipment and overhead lines thereto. The standards and equipment will be supplied by the Corporation.

Form of Tender, Specification and General Conditions of Contract may be obtained from the Street Lighting Superintendent, Hacking St, Bury.

Tenders must reach me in a plain sealed envelope endorsed "Tender for Street Lighting" not later than 1 May, 1954.

EDWARD S. SMITH,
Town Clerk.

Town Hall,
Bury. (H 472)

CITY OF MANCHESTER

THE Welfare Services Committee invite tenders for 20 cwt electrically-operated Goods Lift required at New Central Stores, "Newholme," Manchester. Specification and tender form may be obtained from the City Architect, Town Hall. Deposit £1. 1s. (returnable). Tenders, sealed in endorsed envelopes, must be delivered before 10 a.m. on 3 May, 1954.

PHILIP B. DINGLE,
Town Clerk.

7 Apr., 1954. (H 470)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments:

NORTHMET SUB-AREA
HORNSEY DISTRICT

41/54.N.

THIRD ASSISTANT ENGINEER (401)

Candidates should have had a sound technical training and experience in the con-

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struction, operation and maintenance of H.V. and L.V. underground systems.

Salary will be in accordance with Class F, Grade 9, of the National Joint Board Salary Agreement commencing at £607 plus London Weighting.

Apply to the District Manager—Hornsey, Eastern Electricity Board, The Broadway, Crouch End, London, N.8.

NORFOLK SUB-AREA
GREAT YARMOUTH DISTRICT

40/54.R.

DEMONSTRATOR

Candidates should have had domestic science training including electrical housecraft, should preferably hold the E.A.W. Certificate and be competent to plan and give cookery demonstrations, including lectures and advice to consumers on the utilisation of domestic electrical appliances. Previous experience in an Electricity Service Centre is desirable.

Salary will be in accordance with Grade 1 (£400 x £20—£480 x £10—£490) of the National Joint Council Salary Agreement, although progress beyond £440 will be subject to a certificate that the person concerned is capable of undertaking all the duties of the Grade.

Apply to the District Manager—Great Yarmouth, Eastern Electricity Board, Regent Rd, Great Yarmouth, Norfolk.

Future salary and conditions of service for the above appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications by letter, stating age, education, qualifications and experience, with details of present appointment and salary, should be submitted to the Manager concerned within fourteen days of the appearance of this advertisement. (H 444)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

SECOND ASSISTANT DISTRICT ENGINEER
(SHREWSBURY DISTRICT)
SHROPSHIRE AND HEREFORDSHIRE SUB-AREA

Experience necessary in all branches of distribution work including construction, operation and maintenance of high and low voltage underground and overhead distribution systems. Technical qualifications desirable. Salary £633/£643 per annum (N.J.B. Class D, Grade 7).

THIRD ASSISTANT DISTRICT ENGINEER
(WELLINGTON DISTRICT)
SHROPSHIRE AND HEREFORDSHIRE SUB-AREA

Duties involve the construction, maintenance and operation of E.H.V. and L.V. Mains and Substation. Applicants should have had experience with a supply undertaking. Technical qualifications desirable. Salary £587/£600 per annum (N.J.B. Class E, Grade 9).

Apply, in writing, within 14 days, stating age, experience, present salary and position to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

A. STEPHENS,
Secretary.
(H 446)

BRITISH ELECTRICITY AUTHORITY
South Western Division

ASSISTANT ENGINEER (Efficiency) required at East Yelland Generating Station, North Devon.

Superannuation Scheme. Salary, N.J.B. Class "G," Grade 7, £729/£758.

Candidates should be experienced in the operation of a modern generating station. Familiar with heat flow, boiler and turbine testing, compilation and statistical data and all matters appertaining to the economical operation of a generating station.

Applications on Form A.E.6/ACT, obtainable from your place of employment or the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 30 Apr., 1954. (H 448)

CORPORATION OF GLASGOW
Architectural and Planning Department

APPLICATIONS are invited from persons with qualifications in Electrical, Heating and Ventilating or Structural Engineering. Salary within a scale £490/£870 with placing according to age, qualifications and experience. The posts are superannuable, subject to medical examination. Form of application may be obtained from the Principal Administrative Officer, 20 Trongate, Glasgow C.1.

A. G. JURY,
City Architect and Planning Officer.
(H 453)

BRITISH ELECTRICITY AUTHORITY
London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A or C. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.MECH.E. for posts (a) and Corporate Membership for posts (b) an advantage.

(b) 2nd ASSISTANT ENGINEER
(GROUP III GENERATION)
Vacancy No. 54/273

Applicants should be familiar with operational requirements of modern Generating Stations. Knowledge of salary and wage agreements for Electricity Industry an additional qualification. Appointment offers opportunity for experience in executive and administrative functions, and duties will include analysis of returns and programmes, and investigation of engineering problems. Successful candidate will be required to assist the Group Generation Engineer (Operation) in matters relating to control of a large group of stations. Salary, Class AX/EX, Grade 2, £875. 14s./£1,018. 10s., rising ultimately to £1,133 p.a.

(b) MAINTENANCE ENGINEER
(MECHANICAL)
BRUNSWICK WHARF GENERATING STATION
Vacancy No. 54/274

Wide experience necessary in maintenance of modern Generating Plant. Duties will include the co-ordination of maintenance work and programmes covering the mechanical maintenance of the boiler house, turbine house, coal handling plant, etc. Salary, Class K, Grade 7, £912. 9s. p.a.

(a) JUNIOR ENGINEERS
(1) WEST HAM GENERATING STATION
Vacancy No. 54/275
(2) BRUNSWICK WHARF GENERATING STN.
Vacancy No. 54/276
(3) ST. PANCRAS GENERATING STATION
Vacancy No. 54/277
(4) TAYLORS LANE GENERATING STATION
Vacancy No. 54/278

(1) Control room shift duties (Assistance). Salary, Class H, Grade 14, £541. 16s. p.a.
(2) Junior Engineer (Operation). Experience of boiler and turbine operation. Salary, Class K, Grade 15, £572. 5s. p.a.
(3) Generating Station experience an advantage. Good opportunity for gaining further experience. Salary, Class E, Grade 14, £470 p.a.
(4) Experience of Generating Station operation an advantage. Duties will be combined Technical and Operational. Salary, Class F, Grade 15, £427 p.a.

Applications, quoting vacancy number, may be made on form obtainable from Divisional Secretary, B.E.A., London Division, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (H 461)

SOUTH WESTERN ELECTRICITY BOARD

SURVEYOR required at Central Construction Department, Taunton. Candidates should have had experience in practical surveying employing a theodolite and dumpy level, preferably on overhead line work in Electricity Industry.

Salary range £433/£567 per annum.

Successful candidate required to travel extensively throughout Board's area for which allowances are payable. Application forms from Assistant Secretary (Establishments), Electricity House, Colston Avenue, Bristol, to be returned completed within 10 days. (H 459)

THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF SECOND ASSISTANT ENGINEER
(System Planning and Design)
Sub-Area Technical Engineer's Department,
Manchester

APPLICANTS should be familiar with the problems involved in the design of large power networks as applied to city areas. The work will also involve responsibility for the calculations relating to the protective gear relays for the whole of the Sub-Area.

Applicants should have received technical education up to H.N.C. level in Electrical Engineering or equivalent, and preferably have served a recognised engineering apprenticeship. Drawing Office experience will be an additional qualification, and preference will be given to those who are Chartered Electrical Engineers.

Salary Scale: £986/£1,017 p.a. Grade M.7. N.J.B. Conditions.

APPOINTMENT OF SECOND ASSISTANT DISTRICT ENGINEER,
CENTRAL DISTRICT, MANCHESTER

The duties will include the supervision of the erection and maintenance of substation switchgear, laying and jointing of cables, and switching operations on the H.V. and L.V. systems within the District as required. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £772/£802 p.a. Grade H.7. N.J.B. Conditions.

Applications to the Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by 24 Apr., 1954.

APPOINTMENT OF DISTRICT ENGINEER,
WIGAN DISTRICT

Duties will include the control of the District Engineering and Drawing Office Staffs and responsibility for the construction, operation and maintenance of the District distribution systems (overhead and underground). Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,002/£1,046 p.a. Grade F.2. N.J.B. Conditions.

Applications to Sub-Area Manager, No. 2 Sub-Area, The North Western Electricity Board, National Buildings, St. Mary's Parsonage, Manchester 3, by 24 Apr., 1954.

APPOINTMENT OF SENIOR DRAUGHTSMAN, SUB-AREA MAINS ENGINEER'S DEPARTMENT, KENDAL

Applicants should have had experience in layout of indoor and outdoor substations up to 33 kV, overhead line design, and the preparation of schematic and protective system diagrams. Ability to take charge of drawing office essential.

Possession of H.N.C. in Electrical Engineering or equivalent, will be an advantage.

Salary Scale: £567/£671 p.a. Schedule D. Grade 5, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 6 Sub-Area, The North Western Electricity Board, Castle Green, Kendal, by 24 Apr., 1954. (H 436)

SOUTH EASTERN ELECTRICITY BOARD

THIRD ASSISTANT DISTRICT ENGINEER—Brighton and Hove District.

Salary £641/£667 p.a. under N.J.B. Class G, Grade 9. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground distribution systems up to and including 33 kV. Experience of D.C./A.C. change-over an advantage.

Applications naming two referees must reach A. M. Harker, M.A.(CANTAB.), Brighton and Hove Manager SEEBoard, Electric Hse, Castle Sq, Brighton, by 28 Apr., 1954.

JOINTER (E.H.T.) — Tunbridge Wells District.

Wages 3s. 8d. per hour for 44-hour, 5-day week, under N.J.I.C. Agreement. Applicants should be experienced in the jointing of H.V. and L.V. cables including pole boxes and L.V. services.

Application on forms from T. W. Dann, M.ENG., M.I.E.E., District Manager, SEEBoard, Town Hall, Tunbridge Wells, Kent, to be returned giving two referees by 28 Apr., 1954.

A. L. BURNELL,
Secretary.
(H 460)

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited for the positions of Temporary CLERKS OF WORKS in the Transmission (Construction) Department.

Applicants must have had considerable experience in the field of all stages of 132 kV overhead line construction and/or civil works in 132 kV Substations.

Salary will be £11 per week.

Closing date for receipt of applications is 27 Apr., 1954.

Applications, in writing, should be forwarded to the Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham. Please quote Vacancy No. 54/54/ET.

L. F. JEFFREY,
Divisional Controller.
(H 466)

BRITISH ELECTRICITY AUTHORITY
North West, Merseyside and North Wales Division

STATION SUPERINTENDENT required for new generating station at present under construction at Fleetwood. The station will have an installed capacity of 90 MW, pulverised fuel fired boilers, and is due for completion in 1956. Salary £1,087/£1,134 (F.1). Applicants should be qualified engineers with experience in the management of modern steam power plant, preferably P.F., and appreciation of modern concepts of administration, financial control and employee relations. Vacancy No. 52/54.

STATION SHIFT CONTROL ENGINEER required at Accrington Generating Station. Salary £531/£547 (D.10). Vacancy No. 55/54.

Applications to Divisional Controller, British Electricity House, 825 Wilmslow Rd, Manchester 20, before 30 Apr. (H 437)

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS
Assistant Secretary (Education and Editorial)

APPLICATIONS are invited for the above position on the headquarters staff of the Association (shortly to be situated W.C.1) at a salary commensurate with qualifications and experience. Applicants must have experience in electrical engineering and editorial work, a good knowledge of the electrical industry and ability to organise educational activities. Experience in committee work an advantage.

Written applications should be sent to the General Secretary, 54 Station Rd, New Barnet, Herts, not later than Friday, 23 Apr., in envelopes endorsed "Assistant Secretary." (H 451)

BRITISH ELECTRICITY AUTHORITY
Southern Division

APPLICATIONS are invited for a position as:

GENERAL ASSISTANT ENGINEER
(ELECTRICAL)
GENERATION CONSTRUCTION DEPARTMENT

Applicants should be in possession of technical qualifications leading to corporate membership of a recognised professional institution, preferably have had experience in a manufacturer's works or on erection, and possess some knowledge of the lay-out of large switchgear or cabling installations.

Salary N.J.B., AX/CX, Grade 8, £501/£675.

Special application forms, obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, should be returned by 30 Apr., 1954. (H 445)

HERTFORDSHIRE COUNTY COUNCIL
County Architect's Department

APPLICATIONS are invited for the appointment of an ASSISTANT ELECTRICAL ENGINEER, Grade I, £490/£535.

Applicants should hold the Ordinary National Certificate in Electrical Engineering. Previous Local Government experience not essential.

Applications, together with the names of three referees, to County Architect, County Hall, Hertford, Herts, not later than 24 Apr., 1954. (H 423)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

APPLICATIONS are invited for the following positions in the Generation (Operation) Department. N.J.B. service conditions, superannuable appointments, salaries within Schedule "A" of the Agreement:

(a) ASSISTANT MAINTENANCE ENGINEER (Electrical) at Ironbridge Power Station, Grade H8, commencing salary £717 per annum. (Vacancy No. 642 MD).

(b) STATION SHIFT CONTROL ENGINEER at Nechells "A" Power Station, Grade F10, commencing salary £577 per annum. (Vacancy No. 643 MD).

(c) JUNIOR ENGINEER at Nechells "B" Power Station, Grades J18 to J14, commencing at £402 per annum. (Vacancy No. 644 MD).

Applicants for these positions should have received a sound technical training and a thorough knowledge for (a) of power station electrical maintenance and for (b) of the control of steam generating plant and main switchgear. Appropriate technical qualifications an advantage.

Apply on form AE6, quoting the vacancy number, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 1 May, 1954. (H 464)

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

ENGINEERING DRAUGHTSMEN (CIVIL)
CONSTRUCTION DEPARTMENT
Vacancy No. 1/54/ET

Candidates should have experience in design and detail of reinforced concrete structures, piled and slab foundations for heavy plant, culverts, cable subways, etc., for general building construction drainage and sanitation schemes, associated with official and administrative buildings.

The salary will be in accordance with Grade 5 (£567/£671 per annum) or Grade 6 (£433/£567 per annum) of Schedule D of the National Joint Board Agreement.

ENGINEERING DRAUGHTSMEN (MECHANICAL)
CONSTRUCTION DEPARTMENT
Vacancy No. 2/54/ET

Senior Draughtsmen are required in the Mechanical Section of the Construction Department at North Wilford Power Station. Candidates should have experience in one or more of the following:

(i) Design and layout of Power Station equipment, including turbo-alternators, boiler plant, coal and ash plant, and general station auxiliaries.
(ii) H.P. and L.P. steam and feed pipework. Condensing plant and feed heating systems.
(iii) Conveyor plant, coal handling systems and material handling of station auxiliary equipment.

The salary will be in accordance with the National Joint Board Agreement, Grade 5 (£567/£671 per annum) and Grade 6 (£433/£567 per annum) of Schedule D according to experience.

ENGINEERING DRAUGHTSMEN (ELECTRICAL)
CONSTRUCTION DEPARTMENT
Vacancy No. 3/54/ET

Candidates should have experience in the preparation of layouts and diagrams for the installation of E.H.T. and L.T. Switchgear, transformers, E.H.T. and L.T. cables; knowledge of protective gear systems would be an advantage.

The salary will be in accordance with the National Joint Board Agreement Grade 5 (£567/£671 per annum) and Grade 6 (£433/£567 per annum) of Schedule D according to experience.

STATION CLERK
DRAKELOW POWER STATION
Vacancy No. 52/54/ET

Candidates should have had experience in the administrative work of a generating station including stores accounting, calculation and payment of wages and work in connection with suppliers accounts.

The salary will be within Grade 4 (£605/£665 per annum) of the National Joint Council Agreement.

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The closing date for receipt of applications is 22 Apr., 1954.

SECTION LEADER
CIVIL ENGINEERING DESIGN
CONSTRUCTION DEPARTMENT
Vacancy No. 55/54/ET

Candidates should have experience in design and detail of heavy reinforced concrete structures, heavy foundations, retaining walls, bridges and the like.

Preference will be given to candidates who are Corporate Members of the Institute of Civil Engineers or equivalent qualifications.

Salary will be in accordance with Grade 3, £780/£884 per annum of Schedule D of the National Joint Board Agreement.

Closing date for receipt of applications is 3 May, 1954.

SHIFT CONTROL ENGINEER
FREEMAN'S MEADOW GENERATING STATION
LEICESTER
Vacancy No. 56/54/ET

It is desirable that applicants should have the Higher National Certificate qualification and have had experience in control duties in a large Power Station.

Salary in accordance with Class H, Grade 10 (£641/£667 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications is 3 May, 1954.

The above positions will be pensionable within the provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form which may be obtained from the Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote Vacancy Number.

L. F. JEFFREY,
Divisional Controller.
(H 465)

BRITISH ELECTRICITY AUTHORITY

INVITE applications for the appointment of TRANSMISSION DESIGN ENGINEER in the Chief Engineer's Department. The person appointed will be responsible to the Deputy Chief Engineer (Transmission) for all matters relating to the Design of the Authority's main transmission systems, including the supervision and direction of the staff concerned with plant and equipment design and system design and development.

Salary will be within the provisional scale £2,250 p.a., rising by annual increments of £100 to £2,750 p.a. Letters of application stating age, qualifications, experience, present position and salary should be forwarded to D. Moffat, Director of Establishments, at Winsley St, London, W.1, to be received by 1 May, 1954. Quote reference AE/475. (H 452)

YORKSHIRE ELECTRICITY BOARD
Area Board Headquarters

SENIOR ASSISTANT ENGINEER
(OVERHEAD LINES)
DISTRIBUTION DESIGN (MAINS) SECTION

APPLICANTS must have had considerable experience in the design, planning and construction of overhead distribution lines for voltages up to 66 kV, and must be prepared to act as a specialist in all matters relating to overhead distribution, including statutory requirements.

They should preferably possess a University degree, and be Corporate Members of the Institution of Electrical Engineers, or possess equivalent qualifications.

Salary, N.J.B., Class AX/DX, Grade 1, Schedule C £970/£1,103, rising to £1,198 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to Secretary, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, Leeds, not later than 29 Apr., 1954.

No. 3 (Sheffield) Sub-Area

SHEFFIELD SOUTH DISTRICT
GENERAL ASSISTANT DISTRICT ENGINEER

Applicants must hold at least the Higher National Certificate in Electrical Engineering and should have had experience in con-

continued in next column

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struction and maintenance work, and be able to carry out operation duties on 11 kV and L.V. overhead and underground mains in a district containing a heavy industrial and densely developed residential area surrounded by a rural area.

Salary, N.J.B., Class G, Grade 11, £573/£596 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 29 Apr., 1954.

No. 7 (Grimsby) Sub-Area

SCUNTHORPE DISTRICT
ASSISTANT CONSUMERS' ENGINEER
(STREET LIGHTING)

Applicants should hold preferably the Higher National Certificate in Electrical Engineering or an equivalent qualification, and should have experience in the planning of street lighting extensions and be experienced in the various systems of street lighting and the operation of automatic control systems, and have experience in estimating.

Salary, N.J.B., Class F, Grade 10, £577/£598 per annum.

GRIMSBY DISTRICT
ASSISTANT INSTALLATION ENGINEER

Applicants should have a good technical background and possession of the Higher National Certificate in Electrical Engineering would be an advantage. They must have had practical experience in the supervision of domestic, agricultural and industrial installation work including the preparation of estimates and tenders.

Salary, N.J.B., Class F, Grade 10, £577/£598 per annum.

JUNIOR ENGINEER
(INSTALLATIONS AND CONTRACTING)

Applicants should have technical training and preference will be given to those possessing the Ordinary or Higher National Certificate in Electrical Engineering. The successful applicant will be required to assist the Assistant Installation Engineer in the supervision of domestic, agricultural and industrial installation work including the preparation of estimates and tenders.

Salary, N.J.B., Class F, Grade 15/14, £402/£466 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Rd, Grimsby, not later than 29 Apr., 1954.

No. 6 (Hull) Sub-Area

BRIDLINGTON DISTRICT
GENERAL ASSISTANT DISTRICT ENGINEER

Applicants should be Graduate Members of the Institution of Electrical Engineers or hold equivalent qualifications, and have had experience in the construction, operation and maintenance of E.H.T. and L.T. overhead and underground distribution systems, in a mixed Urban and Rural District.

The successful applicant will be required to reside in Bridlington and to undertake standby duties.

Salary, N.J.B., Class D, Grade 11, £500/£516 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 6 (Hull) Sub-Area, Yorkshire Electricity Board, Ferensway, Hull, not later than 29 Apr., 1954.
(H 462)

SOUTH WALES ELECTRICITY BOARD

REQUIRE an ASSISTANT in the Commercial Department at District 462 (Newport) in the Eastern Sub-Area.

Successful applicant will be required to deal with inquiries for new supply and assist with Industrial D.C./A.C. changeover.

Salary, Class F, Grade 12 (£507/£516/£525) of the N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience, and giving three referees, to be addressed to the Secretary to arrive by 24 Apr., 1954.

St. Mellons, Cardiff. D. G. DODDS, Secretary.
(H 463)

BRITISH ELECTRICITY AUTHORITY
Yorkshire Division

APPLICATIONS are invited for the appointment of POWER STATION SUPERINTENDENT at Blackburn Meadows Power Station, Sheffield.

Salary £1,235/£1,289 per annum. Class H, Grade 1, National Joint Board Agreement.

Applicants should have had wide experience in the operation and maintenance of large modern power station plant and have held a position of responsibility involving the control of staff.

Preference will be given to engineers who are Corporate Members of the Institution of Electrical Engineers and/or Institution of Mechanical Engineers or who hold equivalent qualifications.

Applications on Forms A.E.6/ACT, obtainable from the Divisional Secretary (Establishments), British Electricity House, St. Mary's Rd, Leeds 7, to be returned within 14 days of the appearance of this advertisement.

G. A. VOWLES,
Divisional Controller.
(H 458)

APPLICATIONS are invited for the posts of OVERHEAD LINESMEN to be located in the Drakelow Area. Experience of 132 kV steel tower lines essential. Conditions and wages in accordance with N.J.I.C. Schedule. Applications, stating age, experience, etc., should be submitted through Ministry of Labour, to Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham. Please quote Vacancy No. 9/54/ET. (H 450)

APPLICATIONS are invited for the posts of OVERHEAD LINESMEN to be located at a Transmission Section near Coventry. Experience of 132 kV Steel tower lines essential. Conditions and wages in accordance with N.J.I.C. Schedule. Applications, stating age, experience, etc., should be submitted through Ministry of Labour to Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham. Please quote Vacancy No. 34/54/ET. (H 449)

A LIGHTING ENGINEER with experience in planning of Street Lighting and Industrial Lighting installations required by Revo Electric Co., Ltd., at their Head Office in Tipton. Apply in writing giving details of technical qualifications and experience to the Personnel Manager, REVO ELECTRIC CO., LTD., Tipton, Staffs. (H 442)

A WELL-KNOWN Electrical Company has a vacancy for a SENIOR SALES ENGINEER based on their London office. The successful applicant must be a trained electrical engineer with Ordinary National Certificate as a minimum qualification and with previous experience in the London or South Eastern counties area. The post carries a responsibility for the organisation and control of three sales engineers. A generous salary is offered together with non-contributory pension scheme. — Box No. 3451, Electrical Times. (H 396)

A vacancy exists in the Engineering Organisation Super Tension Development Section of BRITISH INSULATED CALLENDER'S CABLES LIMITED at 38 Wood La, London, W.12, for a GRADUATE ENGINEER capable of accepting a large measure of responsibility for all aspects of supertension cable and accessory development. A previous connection with this kind of work would be an advantage. Pension Fund. 5-day week. Apply in writing, stating age, qualifications and experience, and quoting reference No. L/29/54 to Staff Officer, BRITISH INSULATED CALLENDER'S CABLES LIMITED, 21 Bloomsbury St, London, W.C.1. (H 430)

ASSISTANT required by Consulting Engineer. Must be experienced in use of insulation and continuity testing sets, also conversant with modern A.C. and D.C. power and light circuits. Single man residing London or near preferred. Apply—Box 3465, Electrical Times. (H 429)

ASSISTANT INSULATION ENGINEERS: Young Engineers possessing a degree or Higher National Certificate in Electrical Engineering are required to undertake experimental and theoretical investigations in connection with insulating materials, techniques and associated problems. Experience of similar work desirable, but other applicants with suitable qualifications will be considered for training. Salary according to age, qualifications and experience. Apply with full particulars to the Chief Engineer, A. REYROLLE AND COMPANY LTD., Hebburn, Co. Durham. (H 431)

AGENT wanted with established connections amongst Electrical Engineering Manufacturers in Lancashire and Cheshire to handle Precision and Industrial Electrical Indicating Instruments and Testing Sets. Commission basis.—Box No. 3431, Electrical Times. (H 359)

BROOKHIRST SWITCHGEAR LTD., Chester. invite applications for the position of DEVELOPMENT MANAGER. Duties will include full responsibility for the development and design of all types of electric control gear and the work of the Laboratory, Drawing Office and Workshop of the Development Department. Applicants should be professional electrical engineers who have had considerable experience in the development and design of electrical equipment, preferably in relation to control gear. This is a senior appointment carrying a good starting salary. Apply giving particulars of age, education, training and experience, and salary required to Personnel Manager, BROOKHIRST SWITCHGEAR LTD., Chester. Applications in response to earlier advertisements should not be re-submitted. (H 305)

CALCULATOR required for large Midland Industrial Undertaking. Educational requirements Engineering Degree or equivalent, knowledge of heat transfer and thermodynamics an advantage. Position permanent and pensionable. Good prospects. Age 24/32. Full details of training, experience, etc., to Chief Engineer.—Box No. 3445, Electrical Times. (H 379)

COMMERCIAL Engineer vacancies. FUSEGEAR SALES / CONTRACTS ENGINEERS are required by The English Electric Co., Ltd., Liverpool. H.N.C. electrical and drawing office experience are essential qualifications. Write, quoting Ref. 443G to Dept. C.P.S., 336/7 Strand, W.C.2. (H 384)

DEPUTY POWER STATION SUPERINTENDENT required for a new Power Station of 30 MW capacity together with a Distillation Plant having a capacity of two million gallons per day installed in the STATE OF KUWAIT, Persian Gulf. Applicants should have held a Deputy Station Superintendent's position for at least three years. Preference will be given to applicants under 40 years of age. Experience with oil and gas fired boilers, condensing and back pressure turbo-alternators and large triple effect evaporators will be an advantage. Applicants should also have a working knowledge of Power Station chemistry. Full details of qualifications, training and experience must accompany the application. The starting salary offered is from £1,300 to £1,500 per annum according to experience, plus a living allowance. Free furnished bachelor quarters and medical attention are provided. The contract in the first instance is for two years and may be extended. Married accommodation is difficult and applicants must be prepared to occupy bachelor accommodation for at least the first year of service. Applications to be addressed to the Secretary, EWBANK AND PARTNERS LIMITED, Engineering Consultants, 10/11 Grosvenor Pla, London, S.W.1. (H 424)

ELECTRICAL ENGINEER required, familiar design and planning all types electrical installation and layouts; salary according to experience. Apply T. P. BENNETT AND SON, 43 Bloomsbury Sq, W.C.1. (H 426)

DESIGN ENGINEER required for development of structures for Overhead Electrical Transmission Lines, Railway Electrification, Aerial Ropeways, Floodlight Towers, etc.

Successful applicant, who should have had a thorough theoretical training and practical experience in the design and application of these structures, would be expected to control and organise his own Department.

Good prospects are offered to a man of initiative and resource.—Box No. 3429, Electrical Times. (H 358)

ELECTRICAL ENGINEER required for services with a Construction Company operating the Middle East. Qualifications: possession of Ordinary National Certificate essential; Higher National Certificate desirable. Applicants should have had a wide experience of surveying and construction of power net works, both overhead and underground, substation construction and distribution. Experience in the erection and commissioning of power stations and switchgear an advantage. Age 32 to 40 years. Applications to—Box No. 3459, Electrical Times. (H 406)

ELECTRICAL ENGINEER required for the Electrical Department of The Expanded Metal Co., Ltd., West Hartlepool. Should have a sound practical training, drawing office experience, a knowledge of motor control gear resistor calculations, and preferably some experience of electrical heating for industrial applications.

Apply giving full details of experience, technical qualifications, age, whether married or single and salary required, to—Box No. 3421, Electrical Times. (H 321)

ELECTRICAL ENGINEER required, age about 25 years, of Ordinary National Certificate standard, with some experience of dealing with correspondence and knowledge of motor starters and control gear an advantage. Five-day week. Canteen. Apply by letter giving details of past experience and salary required to The Personnel Officer, WOODALL - DUCKHAM CONSTRUCTION CO., LTD., 63/77 Brompton Rd, London, S.W.3. (H 419)

ENGINEERS AND PHYSICISTS required by long-established manufacturer, London, for research and development; specialised knowledge or experience of instruments, metering, electronics and electro-mechanical devices advantageous. Salary £800 upwards. Staff pension scheme; housing assistance where necessary. Write, giving full particulars education, qualifications, experience and present salary.—Box No. 3457, Electrical Times. (H 401)

HAIRDRESSING Wholesalers have vacancy for SALES ASSISTANT in Electrical Equipment Dept. Permanent situation. Five-day week. Apply Nageles, 8/12 Broadwick St, London, W.1. (H 417)

HOOVER (ELECTRIC) MOTORS LTD., Cambuslang, Lanarkshire, have vacancy for ELECTRICAL MAINTENANCE FOREMAN (25-35 years). Applicants must have practical experience in electrical distribution and control gear on machine tools. Knowledge of electronics would be an advantage. Technical education to Higher National Certificate standard or equivalent. Applications should be made in writing to the Employment Officer. (H 386)

JUNIOR EXECUTIVES (30/35 years) required by Sales Organisation of leading Company of Electrical Engineers. Applicants must have experience in electrical industry and be capable of taking higher responsibilities. Central London. Salary £450 to £650 per annum. Pension Scheme. Write giving details of age and experience to—Box No. 3419, Electrical Times. (H 309)

JUNIOR required for the Estimating Dept. of a firm manufacturing Electric Motors and Allied Apparatus to assist in the preparation of Tenders and Quotations. Preferably with some works and test bed experience. London district. Give full details of experience and salary required.—Box No. 3469, Electrical Times. (H 455)

JOHNSON AND PHILLIPS LIMITED

Appointment of Chief Rubber Cable Technologist

Applications are invited for the appointment of Chief Rubber Cable Technologist to fill a vacancy which will shortly be created by retirement.

Applicants must possess extensive experience in the design and manufacture of rubber and thermophastic cables with intimate knowledge of materials and compounds.

The duties involve responsibility for all routine technical work relating to rubber cables and materials and for research and development.

Applications giving full particulars of age, education, training experience and salary required should be sent to:

Employment and Welfare Manager
Victoria Way
Charlton, S.E.7

(H 264)

LABORATORY ENGINEER. Interesting work in development of domestic appliances. Applicants must have first class mechanical/electrical engineering experience in medium/light engineering and possess degree or H.N.C. Write giving details of qualifications, experience and salary required to Personnel Manager, MORPHY-RICHARDS LTD., St. Mary Cray, Kent. (H 439)

LONDON ADVERTISING AGENCY with important electrical clients requires COPYWRITER for technical and general accounts. Must be:

(a) A ready writer,
(b) Accurately and fully briefed on electrical matters, both in supply industry and at consumer end.

Salary £700 upwards according to experience. Write in confidence giving full details of qualifications, age, present job, to: Creative Manager, MATHER AND CROWTHER LTD., Brettenham House, Lancaster Place, London, W.C.2. (H 416)

PROGRESS in manufacturing methods and techniques in connection with heavy rotating electrical machines and Mercury Arc Rectifiers have led to several interesting vacancies in THE ENGLISH ELECTRIC CO., LTD., Stafford, for MANUFACTURING or METHODS ENGINEERS and PRODUCT DEVELOPMENT ENGINEERS. Applications are invited from engineers working in either of these capacities and from those who have a sound background of practical experience in a manufacturing industry, at least O.N.C. and a desire to enter either of these important branches of engineering. Please write quoting ref. 1225B to Dept. C.P.S., 336/7 Strand, W.C.2. (H 421)

POWER HOUSE ENGINEER required immediately for Trafford Park Factory generating own Steam, Electric, Hydraulic and Compressed Air services. Age 30-40 years, high standard Technical training essential. Permanent position with good prospects and superannuation. Salary according to qualifications. All replies treated in confidence.—Box No. 3455, Electrical Times. (H 400)

REPRESENTATIVES required for London Area (also one for Midlands Area) for well known Electrical Manufacturer for wholesalers and manufacturers. State particulars, salary required, etc.—Box No. 3417, Electrical Times. (H 299)

REPRESENTATIVE for South Eastern Counties. Applicants should be resident on the territory. Have good contacts with architects, wholesalers and contractors, and possess their own car. This is an interesting and worthwhile post for a man with right background. Write in confidence to the Sales Manager, M.K. Electric Limited, Wakefield St, N.18. (H 413)

REQUIRED TECHNICIAN to be responsible directly to Managing Director for development and control of existing electric motor manufacturing department producing a full range of A.C. and D.C. machines up to 10 h.p. Applicants must be capable of electrical design and have works management experience. Progressive position. Assistance with housing.—Box No. 3473, Electrical Times. (H 457)

RADIO TECHNICIAN required as Signals Assistant Inspector of Police by Nyasaland Government for one tour of 2-3 years with prospect of permanency. Salary, etc., £651 rising to £1,103 a year. Commencing salary according to experience. Outfit allowance £50. Uniform allowance £10 a year. Free passages. Liberal leave on full salary. Candidates must be between 21 and 30 years of age, of good education and physique, not below 5 ft 7 in. in height, normal vision without glasses. They must have a sound knowledge of H.F. and V.H.F. fixed and mobile simplex and duplex radio telephone systems and low power petrol/electric chargers and alternators. Knowledge of morse and ability to instruct trainees in radio subjects desirable. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M1/36023/EE. (H 438)

SWITZERLAND. TRANSLATOR required by firm of world-wide repute for preparation of technical articles from German texts. Pensionable post. Application should contain details of age, career to date and salary expected.—Box 3463, Electrical Times. (H 422)

SALES ENGINEERS are required by the LANCASHIRE DYNAMO GROUP for their expanding Sales Organisation in Newcastle, Sheffield, Leeds, Manchester and Birmingham. Applicants should give general details of education, technical training, sales experience, present duties and salary level to F.H.S., The Lancashire Dynamo Group, St. Stephen's Hse, Victoria Embankment, S.W.1. (H 353)

SENIOR SALES AND CONTRACTS ENGINEERS are required by THE ENGLISH ELECTRIC CO., LTD., Stafford, for heavy rotating electrical machinery and comprehensive schemes associated with this equipment.

Also JUNIOR ENGINEERS possessing H.N.C. and sound engineering experience, preferably with a commercial bias, are invited to apply. Please write giving full details to Dept. C.P.S., 336/7 Strand, W.C.2, quoting ref. 334D. (H 365)

SENIOR ELECTRICAL ENGINEER wanted by Contractors in process of considerable expansion. Applicants must be conversant with the design, estimating and erection of all types of electrical installations. Company enjoys reputation of good employers, has superannuation scheme and canteen. Details in confidence, training, experience, age and salary required, to Chief Engineer, E.S.I. LTD., 258 Gray's Inn Rd, W.C.1. (H 418)

THE ELECTRICAL RESEARCH ASSOCIATION has a vacancy in its STUDENT APPRENTICE course at the Field Station at Shinfield, in connection with the application of electricity to agriculture and horticulture. Day release is given for attendance at classes leading to the Higher National Certificates or University Degree and training is provided according to the requirements of the professional institutions. Candidates should be qualified to enter the H.N.C. or Degree course. Application should be made to the Director, ELECTRICAL RESEARCH ASSOCIATION, Field Station, Shinfield Green, near Reading. (H 425)

TECHNICAL WRITER required to prepare instruction books, catalogues, press articles. Write Publicity Dept., EVERSHED AND VIGNOLES LTD., Chiswick, W.4, giving age, experience, qualifications and salary required. (H 434)

TECHNICAL ASSISTANT required to carry out measurements in light current and high frequency investigations. Applicants should possess a Higher National Certificate or an equivalent qualification, particularly one including Instrument Technology. Starting salary between £450/£575 p.a. according to age, qualifications and experience. Applications to be sent to The Director, THE ELECTRICAL RESEARCH ASSOCIATION, 5 Wadsworth Rd, Greenford, Middlesex. (H 432)

THE Research Laboratories of THE GENERAL ELECTRIC CO., LTD., are proceeding shortly to fill the following important Scientific and Experimental grade posts.

The Company hopes to appoint to Scientific grade posts men of a sufficient calibre ultimately to fill the highest positions in the Laboratories. Full details of promotion and salary prospects will be given to those called for interview.

(i) ELECTRICAL ENGINEER with good Honours degree for work in the field of Trunk Radio Communications. Candidates should have at least 3 years' experience in the microwave or V.H.F. field.

(ii) ELECTRICAL ENGINEER with good Honours degree to work on the development of new transistor circuits with special reference to communications systems.

Candidates for these positions must have completed National Service if under 26 years of age. Apply in writing to Staff Manager (Ref. RLO/23), Research Laboratories of THE GENERAL ELECTRIC CO., LTD., East La, North Wembley, Middlesex, quoting (i) or (ii), as applicable and giving full particulars of age, qualifications and experience. (H 427)

TRACTION SUPERINTENDENT required by CROMPTON PARKINSON LIMITED, Chelmsford, to take charge of the production of railway, trolleybus and tramway motors, diesel electrical equipment, etc. Applicants, who must have had extensive experience in this class of work, should write giving age, full details of experience and training to the General Manager. (H 433)

TENDERING ENGINEER required by manufacturers of electrical rotating machinery. Previous experience in this field is essential and education to O.N.C. standard desirable. Five-day week, non-contributory staff assurance scheme. Salary according to qualifications and experience.—Box No. 3453, Electrical Times. (H 397)

THE NATIONAL BOILER AND GENERAL INSURANCE CO., LTD., St. Mary's Parsonage, Manchester, 3, require ENGINEERS for appointment as Inspecting Engineers of (a) Boilers and Engines, (b) Lifts and Cranes, and (c) Electrical Plant. First-class M.O.T. Certificate of Competency and/or Higher National Certificate (Mechanical or Electrical), full apprenticeship and practical experience necessary. Apply in own handwriting, giving age (limits 26 to 33), training and experience, academic qualifications and copies of testimonials. Salary £540/£785 (progressive). Non-contributory pension scheme. (H 402)

THERE are vacancies in the Lighting Sales Department of the British Thomson-Houston Company Limited, for:

1. An experienced LIGHTING ENGINEER, preferably with I.E.S. Registration.
2. Young men with technical ability who have completed their National Service and have gained at least an Ordinary National Certificate.

Salary for these vacancies will be in accordance with experience and qualifications. Please send full details of education and career to: The Manager, The British Thomson-Houston Co., Ltd., Mazda Hse, 44 Fitzroy Rd, London, N.W.1, marked: "Lighting Engineer." (H 467)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2.

DOMESTIC APPLIANCE SALES REPRESENTATIVE required by a manufacturer for the Southampton Area. Candidates must have experience of modern electrical appliances and possess a clean driving licence. Replies giving full details and quoting reference IHD should be sent to—Box No. 3463, Electrical Times. (H 473)

THE ENGLISH ELECTRIC CO., LTD., invite applications for appointments in the Switchgear Contracts Dept., of their Liverpool Works. Applicants must have served an apprenticeship and possess a Higher National Certificate in Electrical Engineering. Subsequent experience involving circuit diagram work either in manufacture or electricity supply is also required. These positions offer considerable prospects in an expanding organisation and are pensionable after qualifying period. Reply stating age, qualifications and present employment to Dept. C.P.S., 336/7 Strand, W.C.2, quoting ref. 896B. (H 420)

WANTED TECHNICIAN to develop and manage existing transformer and coil winding department. Must be capable of design and commercial control. Apply Simpson Bros. (of Hapton) Ltd., Hapton, Nr. Burnley, Lancs. (H 357)

WANTED

WANTED. ROTARY CONVERTERS, any size.—Universal, 221 City Rd, London, E.C.1. (H 14)

WANTED, D.C. and A.C. ball-bearing MOTORS, MOTOR GENERATOR SETS, DYNAMOS and ALTERNATORS.—Full details to Britannia Manufacturing Co., Ltd., 22-26 Britannia Walk, London, N.1. (H 12)

WANTED, for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. and H. Cooper Ltd., 176 Brady St, Bethnal Green, E.1. (H 10)

WORK WANTED

A.C. and D.C. MOTOR REWINDS and REPAIRS. Prompt service fully guaranteed. Edgware 5566 (4 lines).—Service Electric Co., Ltd., Stanmore, Middx. (H 20)

ARMATURE REWINDING service to the trade. Vacuums, Drills, Grinders, Hood Dryers, Dental Motors. Vacuum cleaner and drill armatures replaced from stock 24-hour service. Every job guaranteed. All vacuum cleaner parts, hoses, etc., in stock for any make. Apex washer agitator shafts stocked.—Regam Electric Cleaner Service, 95 Park Lane, Leeds 1. (H 25)

CONTRACTOR requires all types of installation and jobbing work. C. M. CARMAN, 107 Linden Way, Southgate, N.14. (H 261)

FISHER FOUNDRIES LTD., Greet, Birmingham 11, for Machine Moulded Precision Castings in gun metal and soft grey iron. Telephone: Birmingham Victoria 0197. (H 53)

WORK WANTED. Capacity available for all types of COIL WINDING.—Box No. 2425, Electrical Times. (H 23)

FOR SALE

A HIGH VACUUM IMPREGNATION UNIT or single or batch coil impregnation service to R.I.C. Specification 214 or individual requirements. — Blickvac, 505 Lordship Lane, S.E.22. Tel: Forest Hill 7089. (H 24)

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, SWITCHGEAR, EXHAUST FANS, HOISTS, REDUCTION GEARS, new or reconditioned units.—Chi 5105, 67 Rothschild Rd, W.4. (H 15)

A.C. and D.C. MOTORS, GENERATORS from stock.—Service Electric Co., Ltd., Honeypot Lane, Stanmore, Middx. Edgware 5566-9. (H 16)

IMPORTANT SALE OF MODERN MILLING AND ELECTRICAL PLANT
re The Rothervale Manufacturing Co., Ltd., Northallerton Works

SANDERSON, TOWNEND AND GILBERT

Chartered Surveyors,
WILL OFFER FOR SALE
BY PUBLIC AUCTION
ON THE PREMISES
ALVERTON FACTORIES
ROMANBY RD, NORTHALLERTON
YORKSHIRE
on
THURSDAY, 29 APR., 1954
at 1 p.m. prompt
the whole of the Valuable Modern Milling and Electrical Plant and Equipment including briefly—

260 kV Diesel Generator, 750,000 B.T.U. Heat Exchange Unit, Double Drum Dryer, Miracle Mills, Pulmac Mills, Horizontal Grindstones, Conveyors, Elevators, Plansifters, Centrifugal Sifters, Fans, Cyclones, Dust Collectors, Electric Motors, Switchgear, Water Tank, Fuel Tanks, Lathes, etc., etc.

On view, Wednesday, 28 Apr., 1954, 10 a.m.-4 p.m.; Thursday, 29 Apr., 1954, 10 a.m.-12 noon

Catalogues, Price 1s.
obtainable from the Auctioneers' Offices,
88 BOROUGH RD WEST
MIDDLESBROUGH. Tel. 43604/5
And at 3 and 5 Mosley St, Newcastle upon Tyne 1. Tel. 27222;
92, Bondgate, Darlington. Tel. 3303
(H 414)

A.C. and D.C. MOTORS, all sizes, large stocks. Fully guaranteed.—Milo Engineering Works Ltd., Milo Rd, East Dulwich, S.E.22 (Forest Hill 2278-9). (H 11)

CARBON Filament Lamps, Ediswan and Robinson, 50 C.P., 110 and 220 volt, 3s. 6d. each. Large range of all types of electric lamps at lowest prices. SUPLEX LAMPS LTD., 239 High Holborn, London, W.C.1. (H 405)

DON'T forget reconditioned meters are supplied by The Electric Meter Company, Department ET46, Castle Circus House, Torquay. (H 333)

DON'T worry about your electricity bills. Fit 1s. slot electric meters for hotels, bed-sitters, etc. Prices from 50s.—Selectrics, Department E.T., Castle Circus House, Torquay. Tel. 7218. Trade inquiries invited. Trade discount. (H 26)

HUNDREDS OF MOTORS in stock: 1, 2 and 3-ph. and d.c. all sizes. Geared motors. M.G. sets and special equipment made up. Rewinds and redesigns all sizes. 12 months' guarantee on all supplies and rewinds. Lists sent on request.
EDWARDS, WYATT AND COURT LTD.
Grant St, London, E.13
Grangewood 3697 (H 302)

HOUSE Service Meters. The Electric Meter Company, Department ET46, Castle Circus House, Torquay. (H 332)

HOUSE-SERVICE METERS, a.c. or d.c., quarterly or prepayment.—Universal Electrical, 221 City Rd, London, E.C.1. (H 17)

METERS reconditioned, all types, AC/DC, quarterly credit, single and three phase 3/4 wire 2½/100 amp. Prepayment, single, dual and triple coin, fixed or variable tariff 2½/50 amp. Delivery ex-stock, guaranteed, free catalogue lists 200 types. Trade Discount 33⅓%. The Electric Meter Company, Department ET46, Castle Circus House, Torquay. Telephone 7963. (H 331)

12 NEW Brook R. 13 Slip-Ring Motors for sale, 7½ h.p., 1,420 r.p.m., 380/420 V, 3-ph., 50 cy. F. J. EDWARDS LTD., 359 Euston Rd, London, N.W.1. EUS. 4681. (H 468)

FLAMEPROOF MOTORS, M.G. SETS, D.C. MOTORS, GEARED MOTORS, A.C. MOTORS, TRANSFORMERS, CONTROL GEAR. SPECIALS. FLANGE MOTORS
ELECTROPOWER COMPANY LIMITED
Kingsbury Works, Kingsbury Rd, London, N.W.9
Tel.: COLindale 4621/3,
Grams: Lectropows, Hyde, London (HI9p)

MERCURY SWITCHES are made by Hall, Drysdale and Co., Ltd., of 58 Commerce Rd, Wood Green, London, N.22. Tel.: BOW. 7221. (H 18)

NEW and unused Barlow and Whitney electric ovens, 415 V, 3-ph., 4-wire, 40 kW, max. temp. 250° C., complete with recording, process timing and control cabinets, inside measurements 8 ft 6 in. d, 7 ft 3 in. w, 6 ft 5 in. h, offered at less than half cost price. WOODFIELD AND TURNER, Bankfield Hill, Burnley. Tel. 3065. (H 376)

ONE 5 kW 240 V single phase 50 Cycles "Alcomatic" diesel engine lighting set complete with cooling tank and starting batteries, manufactured by ARTHUR LYON AND CO., LTD. In good condition, new October 1951. Available May. Price £300. Can be seen running by appointment. Mold 490. (H 441)

PURLEY CHOKES AND BALLASTS. Our 80-W tapped h.p.f. ballast with starter switchgear-holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s. 6d. each subject.—F. W. Blanshard Ltd. (Dept. E.T.), Purley, Surrey. Uplands 4818-9. (H 21)

STONE 15 kVA Alternator, with exciter, 3-phase, 1,500 r.p.m., 400 V. In good working order, only used for a few hours. £75 or near offer. CLI 6641. (H 428)

TIME SWITCHES for sale. Reconditioned or new. 12 months' guarantee. Immediate delivery. Lists from: J. W. Hughes, 3 St. Thomas' St, London Bridge, S.E.1. (Tel.: HOP 2759.) (H 27)

3 CONTROL Panels, new, 7½ KVA, 200/230 V alternating complete. Fitted with frequency meter, voltmeter, 2 shunt regulators, change-over switch (double pole), 2 double pole cut-outs. Mounted on a Sindanyo panel. SUPLEX LAMPS LTD., 239 High Holborn, London, W.C.1. (H 443)

AGENCIES

AGENT wanted to handle High Grade Electrical Resistance Wires and Tapes in the London Area. Preferably one already calling on Electrical Domestic Appliance, Instrument and Radio Manufacturers.—Box No. 3467, Electrical Times. (H 454)

AUSTRALIAN AGENT, now visiting England, wishes to contact Electrical Manufacturers of electrical appliances, fluorescent lighting equipment and installation materials. L. GETZLER, c/o National Bank of Australasia, Strand, London, W.C. (H 469)

BESCOL Electric Ltd., Birmingham, 8, manufacturers of Domestic Electrical Appliances, require AGENTS for the North Eastern, South and South Eastern areas of England. (H 399)

BESCOL (ELECTRIC) LTD., Birmingham 8, manufacturers of Domestic Electrical Appliances, require AGENTS for Northern and Southern Ireland and the Midlands of Great Britain. (H 440)

SMALL progressive firm of electrical and mechanical engineers, principally engaged upon the manufacture of motors and transformers require AGENTS in the following areas: Somerset, Devon and Cornwall; Northern Ireland; Eire.

Organisations employing technical staff, and having similar experience in this field, together with connections with large industrial users and Supply Boards need only apply.—Box No. 3471, Electrical Times. (H 456)

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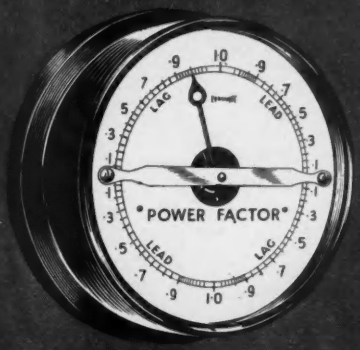

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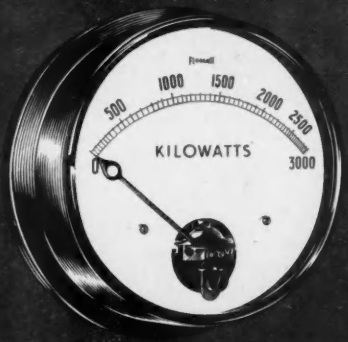

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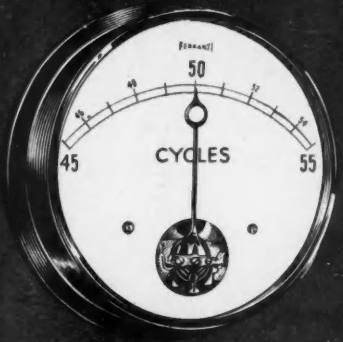

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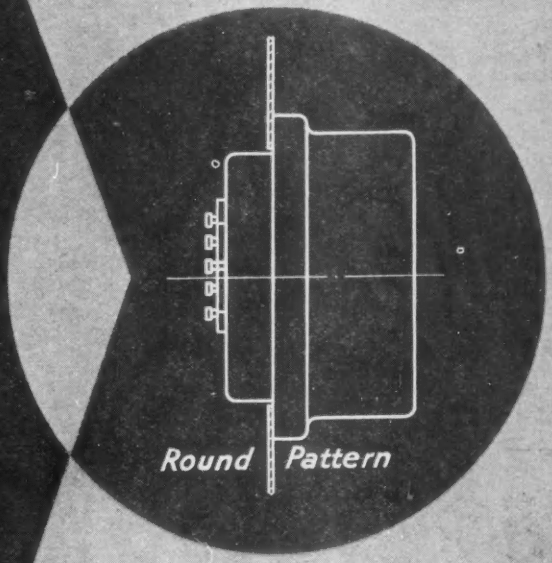

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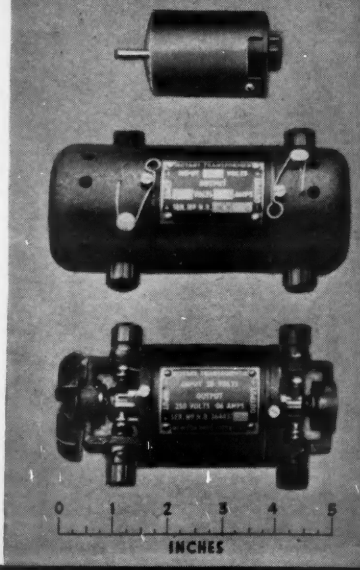

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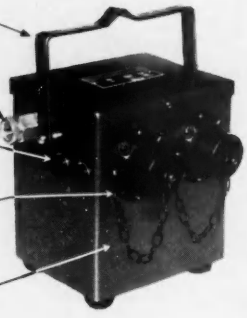

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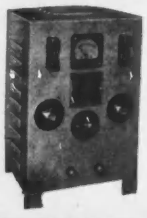

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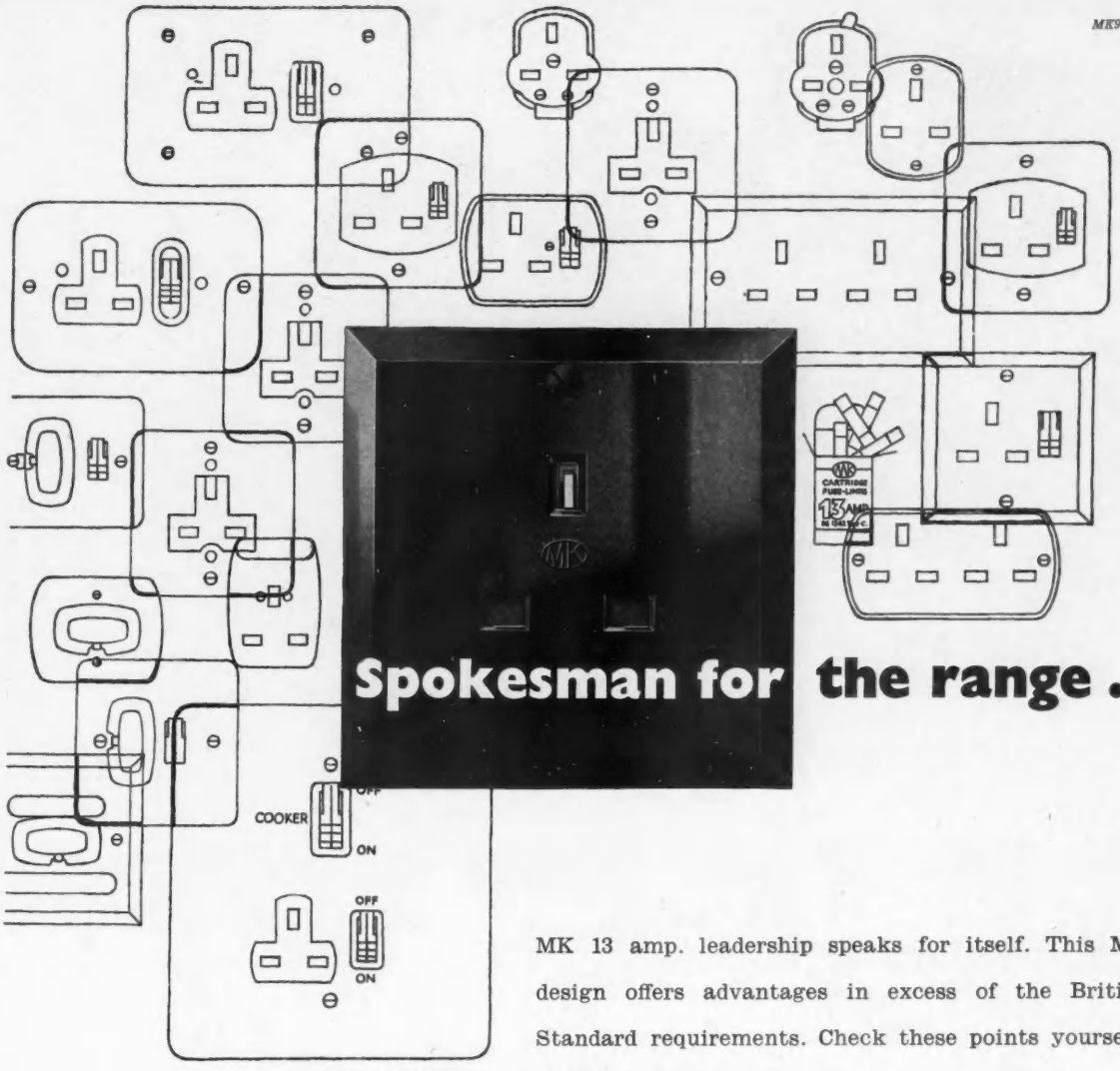

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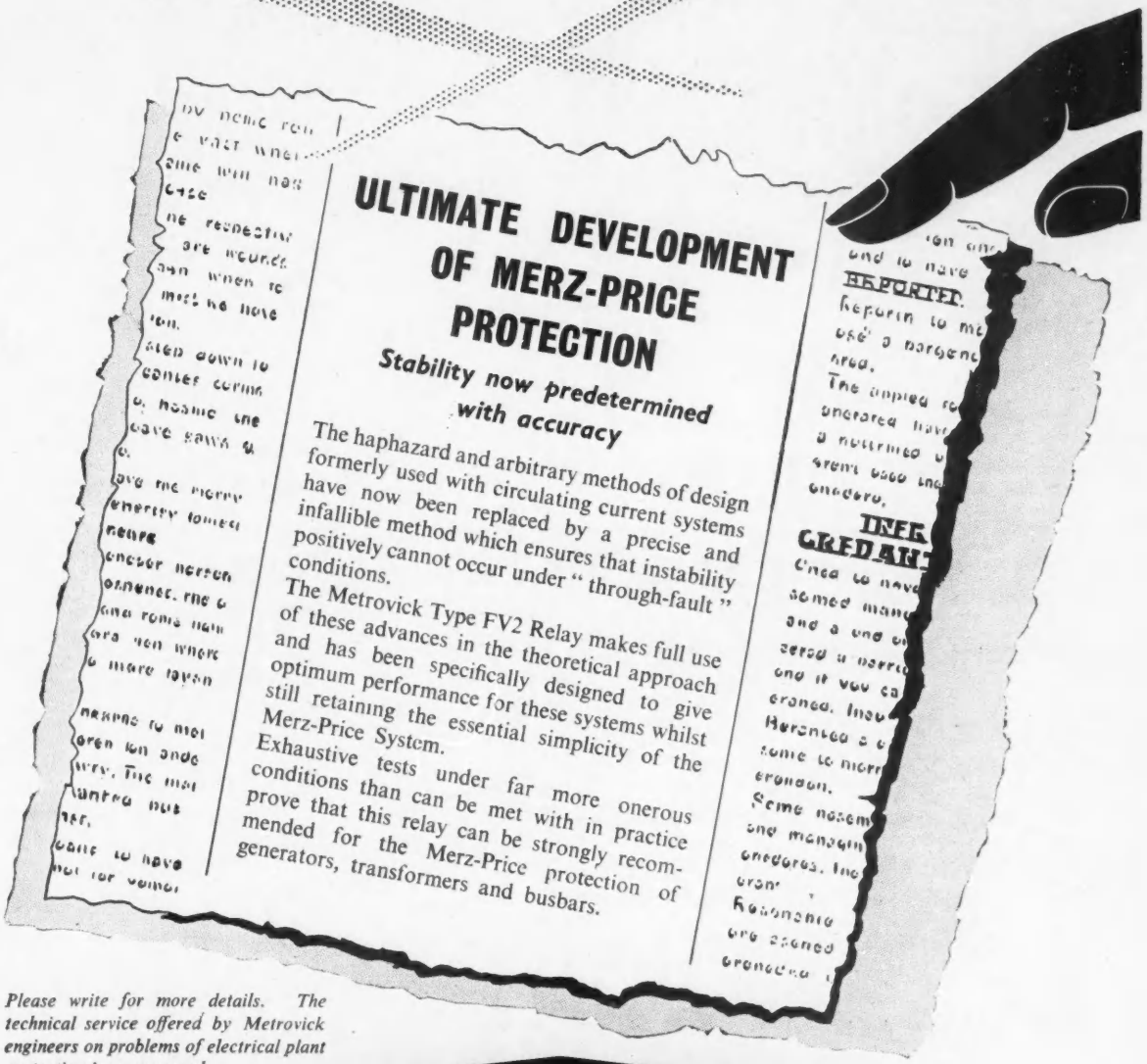
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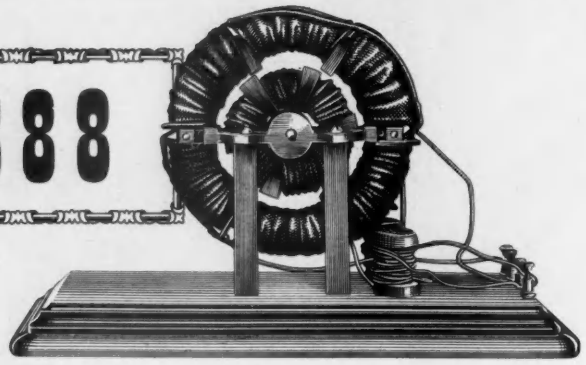

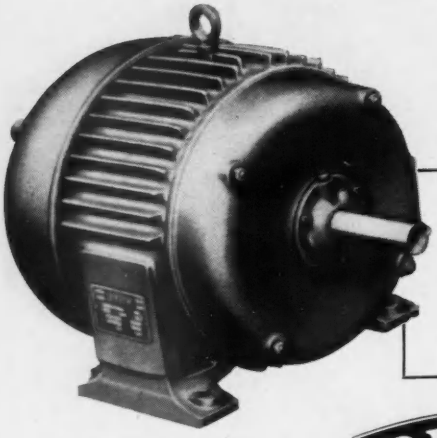

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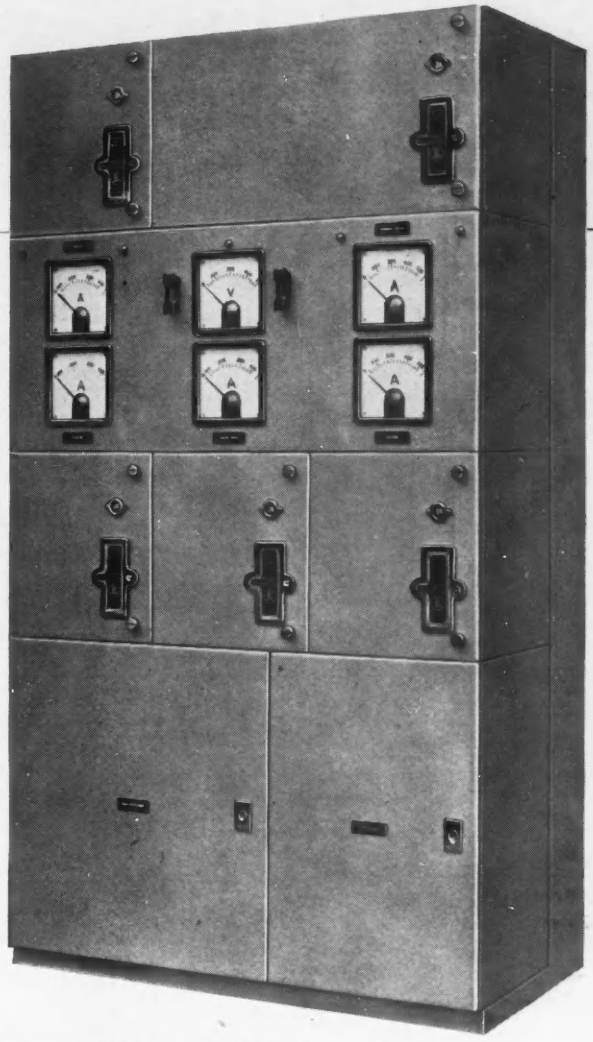

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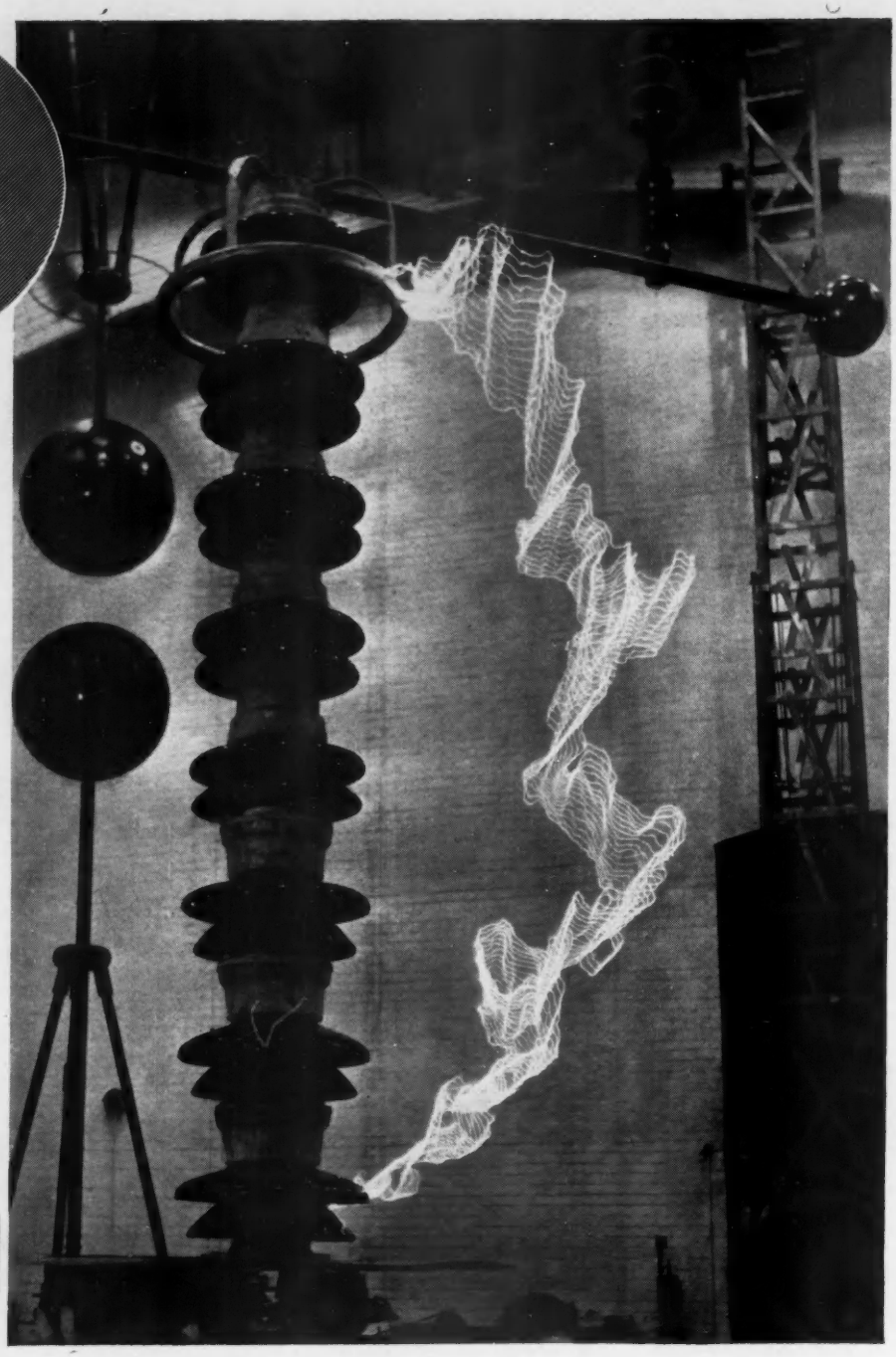

One of the S.P.P. 8-unit post insulators for the B.E.A. 275 kV. Super Grid undergoing the 50 cycle flashover test at 705 kV. during the official type tests carried out at the million volt laboratory at Stourport-on-Severn.

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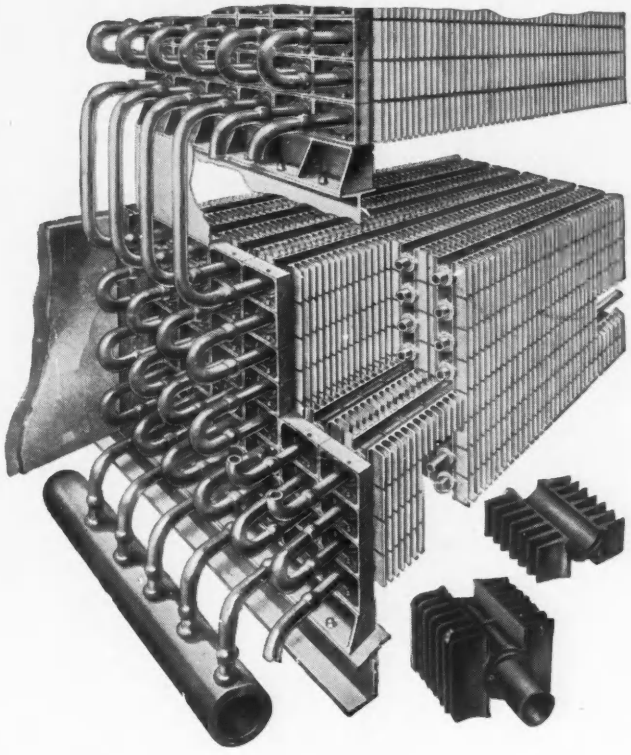

The illustration shows the construction of the tube elements in the Senior Welded Economiser, as used in modern Generating Stations. Maximum heat transfer is effected by H-gilled sleeves which are shrunk on cold-drawn steel tubes, all tube joints being welded. The construction is suitable for all operating pressures.

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